Viking Labs

JDR INSTRUMENTS

Instruction Manual

20 MHz Dual Trace Oscilloscope

Model 2000

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This model is a dual trace 20MHz oscilloscope using high brightness CRT.

The vertical amplifiers have high sensitivity of 5mV/DIV and the frequency characteristic response with the smooth rolloff exceeding 20MHz. The highest triggering sweep speed is 0.2 μsec/DIV.

FEATURES

1) Component Tester
2) Wide bandwidth & high sensitivity
3) Very low power consumption
4) High sensitivity X-Y mode
5) Z axis (intensity modulation)
6) TV VIDEO SYNC Filter
7) High frequency rejection filter in the trigger circuit
8) Front panel electrical trace rotator
9) Regulated power supply circuit for accuracy

COMPONENT TESTER is the special circuit with which a single component or components in or out of actual circuit board can be easily tested requiring no power to drive the circuit.

The display shows FAULTS of components, size of a component value, and characteristics of components, and half-dead components under a dynamic test.

SECTION 2 SPECIFICATIONS

VERTICAL DEFLECTION

Deflection Factor	5mV to 20V/DIV on 12 ranges in 1-2-5 step with fine control.
Bandwidth	DC: DC to 20MHz(-3dB)
	AC: 10Hz to 20MHz(-3dB)
Risetime	Less than 17.5nsec
Overshoot	Less than 3%
Input Impedance	1MΩ shunted by 20pF±3pF(Max imput: 600Vp-p or 300V DC + AC peak)
Operating Modes	Ch-A, CH-B, DUAL and ADD
Chop Frequency	200kHz approx.
Channel Separation	Better than 60dB at 1kHz
CH-B Polarity	CH-B can be inverted

TIME BASE

Type	Automatic and triggered. In automatic mode, sweep is obtained without input signal.
Sweep Time	0.2μsec to 0.5sec/DIV on 20 ranges in 1-2-5 step with fine control and X-Y
Magnifier	X5 at all ranges
Linearity	Less than 3%

TRIGGERING

Sensitivity	INT: 1 DIV or more
	EXT: 1 Vp-p or more
Source	INT, CH-B, LINE or EXT
Triggering Level	Positive and Negative, continuously variable level control Pull for AUTO
Range	20Hz to 20MHz or more
Sync	AC, HF Rej, TV(each + or −)
	At TV Sync TV-H(Line) and TV-V(Frame) sync are switched automatically by SWEEP TIME/DIV switch.
	TV-V: 0.5sec/DIV to 0.1msec/DIV
	TV-H: 50μsec/DIV to 0.2μsec/DIV

HORIZONTAL DEFLECTION

Deflection Factor	5mV to 20 V/DIV on 12 ranges in 1-2-5 step with fine control.
Frequency Response	DC to 1MHz(−3dB)
Input Inpedance	1MΩ shouted by 20pF ±3pF
Max Input Voltage	300V DC + AC peak or 600Vp-p
X-Y Operation	X-Y mode is selected by SWEEP TIME/DIV switch
	CH-A: Y axis
	CH-B: X axis
Intensity Modulalion	Z Axis: TTL Level (3Vp-p ~ 50V) + bright, − dark.

OTHER SPECIFICATIONS

CRT HV	APPROX-2KV
Calibration Voltage	0.5Vp-p ±5%, 1 kHz Square Wave
Power Requrements	AC: 100V/120V/220/V240V/, 50/60Hz, 19W
Weight	7kg approx.
Dimensions	162(H) X 294(W) X 352(D)mm

SECTION 3 OPERATION

3-1 INITIAL OPERATION

Inspect the carton for serious damage which might have caused failure of the instrument during transportation. If damage is noted, notify the agent you bought from before turning on.

INITIAL AC OPERATION

1. Prior to any kind of operation of the instrument, proceed as follows to get familiarized with the instrument.
   a) Set the POWER switch to OFF.
   b) Turn all the three POSITION controls to mid-position.
   c) Turn INTENSITY control to mid-position.
   d) Push the PULL 5X MAG control for normal.
   e) Pull TRIGGERING LEVEL control for AUTO.
   f) The rest of the controls remain at any position for normal operation.
   g) Check the line voltage.
2. Connect the AC line cable into the AC receptacle on the rear panel of the instrument, and plug into an AC power outlet.
3. Turn POWER to ON. After approximately 20 seconds, trace lines appear on CRT screen. If no trace lines appear, rotate INTENSITY clockwise till trace lines are easily observed.
4. Adjust FOCUS and INTENSITY controls for clear trace lines.
5. Readjust Vertical and Horizontal POSITION controls for locations required.
6. Connect a probe (10:1) to INPUT of CH-A and hook the tip of the probe to CAL 0.5Vp-p output.
7. Rotate CH-A Vertical attenuator VOLTS/DIV switch to 10mV/DIV and turn the VARIABLE on the same axis clockwise to detent. Turn TRIGGERING SOURCE to CH-A. Then a square-wave of 5 divisions is displayed on the screen.
8. If the square-wave is distorted, adjust the trimmer of the probe till it becomes a good square-wave.
9. Remove the probe tip from CAL 0.5Vp-p output. Now, the oscilloscope is ready for use.

3-2 CONTROLS & INDICATIONS

1. VERTICAL INPUT
   Vertical input terminal for CH-A.

2. AC-GND-DC
   Vertical input coupling for CH-A. In AC position, the DC component of input signal is blocked by a capacitor. In GND position, the input terminal opens and the input of the internal amplifier is grounded. In DC position, the input terminal is directly connected to the amplifier and all components of input signal are displayed.

3. MODE
   CH-A: Waveforms of CH-A are displayed.
   CH-B: Waveforms of CH-B are displayed.
   DUAL: In the range from 0.5 sec/DIV up to 1 msec/DIV, both channels are chopped at about 200 kHz.
   In the range from 0.5 msec/DIV up to 0.2 μsec/DIV, both channels are switched alternately.
   ADD: CH-A and CH-B signals are added. By pulling (23) PULL INVERT, SUB mode is obtained.

4. VOLTS/DIV VARIABLE for CH-A.

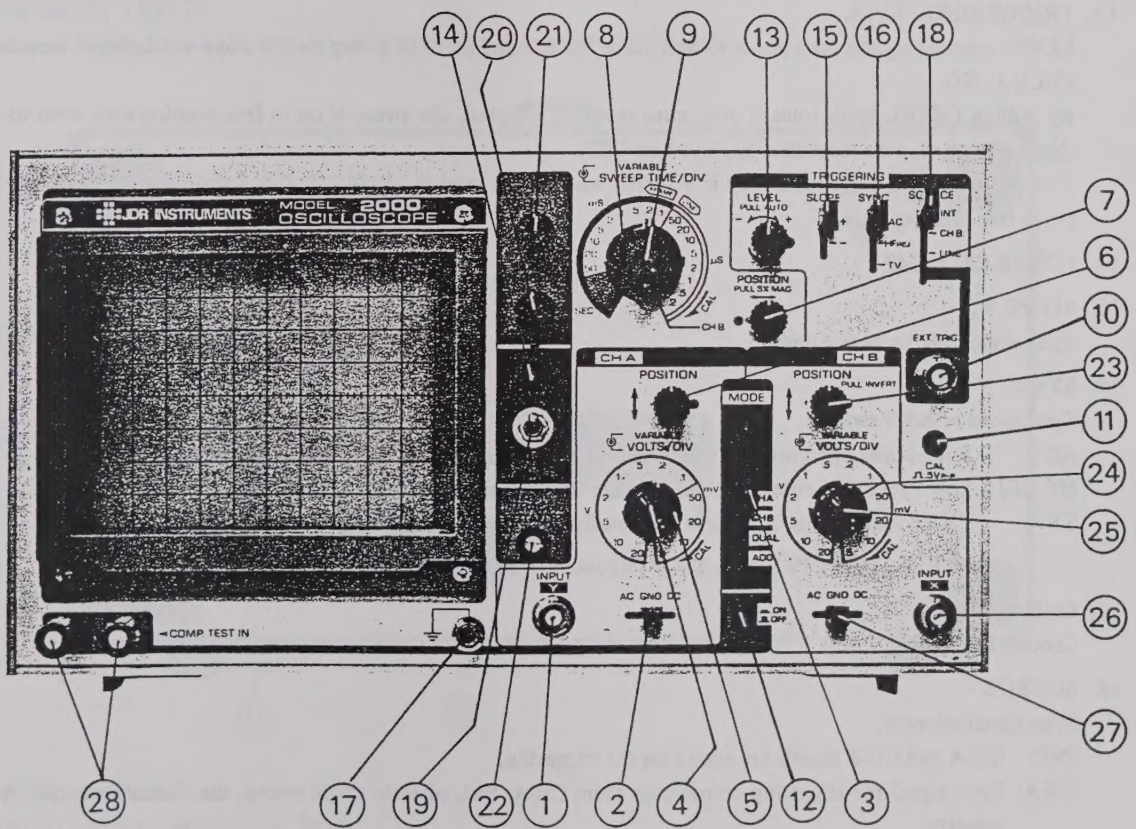


Fig. 1

5. VOLTS/DIV
   Vertical attenuator for CH-A. The scale is graduated in voltage per "DIV" of CRT screen area.
   Calibrated voltage is indicated when the VARIABLE is turned fully clockwise.
   Selectable in 10 calibrated ranges from 5 mV/DIV to 20 V/DIV.

6. VERTICAL POSITION
   Vertical position adjuster for CH-A.

7. HORIZONTAL POSITION and PULL 5X MAG
   Horizontal position adjuster. When pulled, SWEEP TIME is magnified by 5.

8. SWEEP TIME/DIV
   Horizontal sweep time selector. It selects sweep times of 0.2 μsec/DIV to 0.5sec/DIV in 20 calibrated steps. X-Y operation is possible by turning the knob fully clockwise to CH-B.
   Change over between CHOP and ALTERNATE is also accomplished automatically by this selector in DUAL MODE
9. SWEEP TIME/DIV VARIABLE
10. EXT. TRIG
    Input for external triggering signal.
11. CAL
    Calibration voltage terminal. Calibration voltage is 0.5Vp-p of about 1 kHz square wave.
12. COMP. TEST
    Switch to change from oscilloscope to component tester.
    For component testing ⑧ SWEEP TIME/DIV must be set to CH-B for X-Y mode and also both ②-㉗ AC-GND-DC switches to GND positions.
13. TRIGGERING LEVEL
    LEVEL control adjusts sync phase to determine the starting point of sweep on the slope of displayed waveform.
    PULL AUTO
    By pulling LEVEL knob toward you, auto-sweep is effected; the sweep is set in free-running state even when no input signal is applied, with trace line displayed on CRT.
    With trigger signal, triggered-sweep is effected where sync level is adjustable. When sync level is deviated, the sweep is set in free-running state.
14. POWER ON LAMP
15. SLOPE + , –
    Sync slope polarity is selected.
16. SYNC
    Sync mode selector switch..
    AC: For normal operation. In this mode sync signal is directly fed to the sync circuit.
    HF REJ: Low Pass Filter cuts off RF composite of the sync signal.
    TV: TV or Video composite signals are easily triggered.
    SWEEP TIME/DIV selects TV-V (50μsec~0.1 msec) or TV-H (50μsec~0.2μsec)
17. GND
    Ground terminal.
18. SOURCE
    Sync signal selector.
    INT: CH-A and CH-B signals are added on for triggering.
    CH-A: Sync signal for triggering comes only from CH-A. But, when in single sweep, the channel selected by MODE has priority.
    CH-B: Signal from CH-B. The rest is the same as CH-A.
    LINE: AC power line waveform is used as sync signal source.
    EXT: The signal hooked into EXT TRIG becomes the sync signal source.
19. POWER SWITCH
    Turns power on or off.
20. FOCUS
    Focus control to obtain optimum waveform display.
21. INTENSITY
    Adjust the brightness of waveform for easy viewing.

22. TRACE ROTATOR
The earth magnetics effect the trace line. Rotate this with a screw driver for proper trace line.

23. CH-B POSITION, PULL INVERT
CH-B vertical position control. When pulled, the CH-B vertical polarity is inverted. This facilitates SUB MODE measurement at ADD MODE.

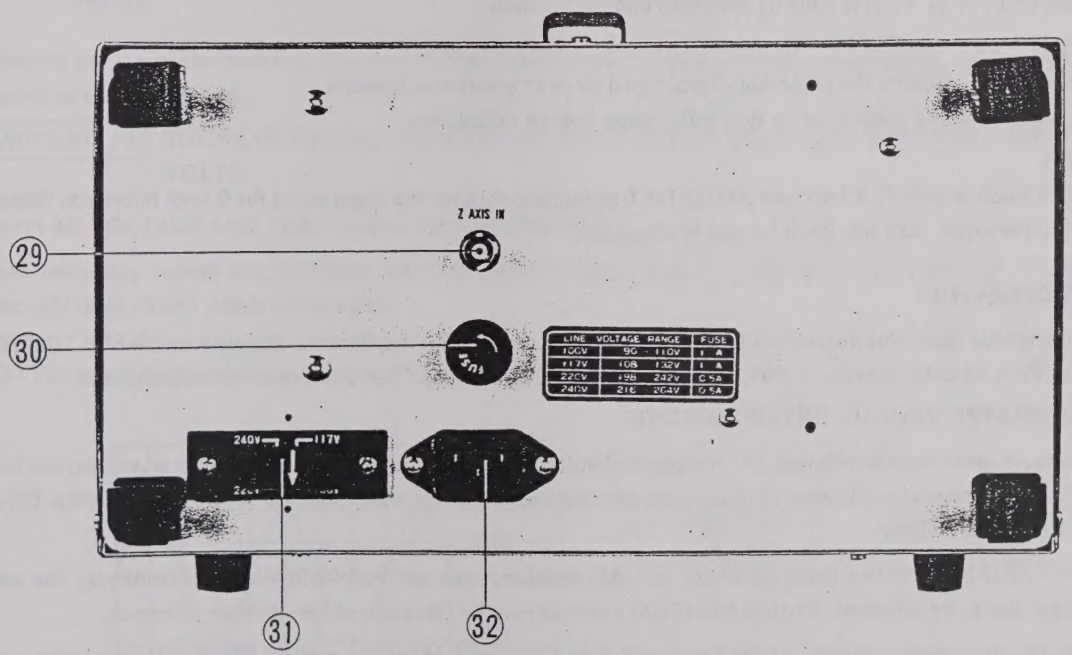
24. VOLTS/DIV
Vertical attenuator for CH-B.

25. VARIABLE

26. VERTICAL INPUT
Vertical input for CH-B.

27. AC-GND-DC
For CH-B, same as ②.

28. COMPONENT TEST IN
Terminals to connect a component or lead wires to a component under test.



29. Z AXIS
External Intersity Modulation Input.

30. FUSE HOLDER
Proper ampere fuse must be in.

31. VOLTAGE SELECTOR
Proper line voltage must be selected where this oscilloscope is used.

32. RECEPTACLE for AC line cable.

3-3 TRIGGERING

Generally, triggered oscilloscopes have the following circuits to display stable waveform on the screen.
Vertical input signal or integral number related signal is used for a sync pulse signal, which is used as a triggering signal. This signal stabilizes the waveform display. However, this triggering must be exactly synchronized to the vertical input signal. And all the knobs should be correctly used.
This model has 4 knobs to control triggering. They are LEVEL, SLOPE, SYNC and SOURCE.

(SOURCES)

When the vertical input signal is supplied to the internal SYNC circuit, it is called INTERNAL TRIGGER.

When the same signal or integral number related signal is applied into the SYNC circuit through EXT TRIG input, it is refered as EXTERNAL TRIGGER. In this model INT, CH-A and CH-B of SOURCE switch are internal triggers.

The internal trigger signal is amplified in the vertical amplifier and triggering becomes easy.

LINE: The AC power line waveform is supplied to the SYNC circuit as a triggering source.

EXT: When SOURCE is turned to EXT, it becomes external trigger which has namely 3 benefits.

1. Triggering signal receives no effects from the vertical circuits.
   EX. Triggering level need be readjusted when VOLTS/DIV knobs are turned because the sync source voltage changes. In such case, unless the external trig input voltage is changed, triggering is very stable and free from vertical controls.
2. Input signal can be easily delayed by the use of the delaying function of a pulse generator.
3. Composite signal or modulated signal can be easily triggered by the signal which composes the composite signal.

(SYNC)

This switch has a selection of the sync circuit coupling. At AC position it becomes AC coupling and DC composite is isolated for stabilized synchronization. HF REJ has a low pass filter to eliminate RF noise interference to synchronization. At TV position either vertical or horizontal sync signal isolation circuit works to ensure the TV signal triggering. Selection of TV-V or TV-H is done by SWEEP TIME/DIV switch.

(SLOPE)

SLOPE switch +, –selects the triggering source signal slope of positive or negative.

At TV sync, triggering point is set to sync pulse rising time or falling time.

(LEVEL)

When this knob is pulled, it becomes AUTO for free running without the input signal for 0 level reference. When a signal is applied to the input, turn this knob for stable triggering.

3-4 X-Y OPERATION

For some special cases, this instrument is specially designed for easy X-Y application. Simply turn SWEEP TIME/DIV switch to CH-B. Then all CH-B functions work as horizontal amplifier, whereas CH-A remains as vertical amplifier.

3-5 CALIBRATED VOLTAG EMEASUREMENTS

Peak voltages, peak-to-peak voltages, DC voltages and voltages of a specific portion of a complex waveform can be measured using this instrument as a voltmeter. Voltages can be measured whenever waveforms are observed using either CH-A or CH-B inputs. Proceed as follows:

1. Set VARIABLE control fully clockwise to CAL position, then set VOLTS/DIV control to display the waveform in proper size to be observed. Vertical POSITION controls may be turned to obtain division reference.
2. For DC or complex signals, set the input switch to GND, and adjust the vertical POSITION control to a convenient reference level. Set the switch to DC and observe the amount of deflection. A positive voltage will deflect trace upwards: a negative voltage will deflect the trace downward. To calculate the voltage reading, multiply the vertical deflection (by division) by the setting of the VOLTS/DIV switch.

NOTE WHEN A PROBE (10:1) IS USED, THE WAVEFORM DISPLAY IS ONLY 1/10 OF THE ACTUAL VOLTAGE MEASURED.

3-6 DUAL TRACE WAVEFORM OBSERVATION

MODE switch to be turned to DUAL. Other procedures are in the same manner as mentioned above.

3-7 TV SIGNAL SYNCHRONIZATION

Set TRIGGERING SYNC to TV (+ or –), then specially designed circuitry provides easy triggering for complexed TV frame and line signal. TV frame and line waveform are easily obtained by simply tuning SWEEP TIME/DIV control.

3-8 ADD & SUB MEASUREMENTS

Simply turn MODE switch to ADD, added waveform of CH-A and CH-B is displayed.
With this MODE at ADD position, subtracted waveform is obtained by pulling INVERT knob which inverts the polarity of CH-B.

3-9 APPLICATIONS

This is a dual trace oscilloscope which has full capability of single trace mode. Thanks to the dual-trace functions, various effective measurements are feasible.

[SINGLE-TRACE APPLICATIONS]
Either Channel A or Channel B can be used for single-trace operation. Channel A is referred to hereunder for simplicity.

Set controls:

AC-GND-DC	AC
MODE	CH-A
SYNC	NORM +
SOURCE	INT
PROBE	to CH-A INPUT Jack

Connect the tip of the probe to the point in the circuit where the wave form is to be measured, and its ground clip to the chassis or the ground part.

CAUTION ! ! ! THE PEAK-TO-PEAK VOLTAGE AT THE POINT OF MEASUREMENT SHOULD NOT EXCEED 600 VOLTS.

3-9-(1) AC VOLTAGE AND FREQUENCY MEASUREMENT

When measuring voltage and frequency, set VOLTS/DIV VARIABLEs ④, ㉕ and SWEEP TIME/DIV VARIABLE ⑨ at their calibrated detent points (clockwise).

(EX) The signal displayed on the CRT is

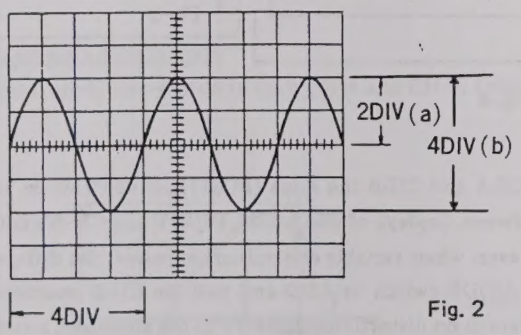


Fig. 2

VOLT/DIV . . . . . at 2V
SWEEP TIME/DIV . . . . . at 5 msec.

(a) Peak voltage . . . . 2V/DIV x 2DIV=4 volts
(b) p-p voltage . . . . 2V/DIV x 4DIV=8 volts
(c) Effective voltage . . . Peak voltage $\div\sqrt{2}$=2V x 2DIV x $\frac{1}{\sqrt{2}}$
=2.828 volts
(d) Frequency (Hz) . . . . . 1/Time (second)

** Time=Number of DIVs for 1 cycle x
value of SWEEP TIME/DIV

Therefore, the Fig 2 waveform is:

$$\text{Frequency}=\frac{1}{5\,\text{m sec} \times 4\,(\text{DIV})}=\frac{1}{20\,\text{m sec}}$$

=50Hz

NOTE ! ! ! The input of this oscilloscope is 1MΩ shunted by 20pF capacitance. When the probe is used in 10:1 attenuation, the impedance becomes 10MΩ shunted by 15pF. Then the voltage reading must be multiplied by 10.

3-9-(2) DC VOLTAGE MEASUREMENT

AC-GND-DC being at AC position, only AC or AC component was displayed on the CRT screen. For DC Measurement, set the switch to GND and pull the TRIGGERING LEVEL knob ⑬ for a trace line, which must be positioned at a certain place as 0 volt reference.

After that, turn the switch to DC. Then the trace line shifts up or down. The value of movement is the DC voltage.

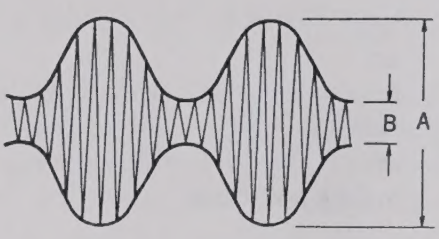
DC voltage = Shift (DIV) x VOLTS/DIV

When the trace line shifts up-ward, the polarity is (+), and down-ward is (−).

3-9-(3) AM MODULATION MEASUREMENT

There are various ways of measurements, but herein this manual the envelope method is introduced. This method is applicable when the carrier frequency is within the frequency bandwidth of the oscilloscope. See Fig. 3.

Fig. 3



$$\text{Mod. } (\%) = \frac{A - B}{A + B} \times 100$$

3-9-(4) DUAL-TRACE APPLICATIONS

MODE switch being turned to DUAL. both Channel A and Channel B works simultaneously.

Then, comparison of two relative signals are easily done such as level, waveforms, phase, etc.

3-9-(5) LEVEL COMPARISON

(EX) OUTPUT/INPUT of an amplifier

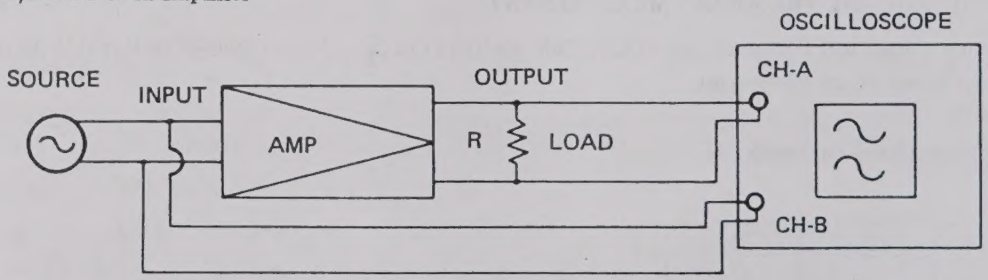


Fig. 4

With the connections of the Fig. 4 set the displays of CH-A and CH-B the same (POSITION controls be adjusted to place CH-B waveform onto CH-A). Then the difference between displays of CH-A VOLTS/DIV and CH-B's is the gain of the amplifier. If the two signals do not match each other even when variable controls are adjusted, the difference is the distortion caused in the amplifier. Then, simply turn the MODE switch to ADD and pull the CH-B position knob for invert (SUB MODE), for viewing only distortion. When there is no distortion originated in the amplifier, a straight trace line is displayed in SUB MODE.

3-9-(6) REPAIRING STEREO SYSTEMS

Every stereo equipment has two symmetrical amplifier circuits.

So, simultaneous comparison of the same stages makes it so easy to locate defective point.

3-9-(7) TV SERVICING

iggered oscilloscope is indispensable. This model has the very convenient TV SYNC circuits of TV-V (Frame) and TV-TV-H (line) for accurate synchronization to view VIDEO SIGNAL, BLANKING PEDESTALS, VITS and Vertical/Horizontal SYNC PULSES.

3-9-(8) COMPOSITE VIDEO ANALYSIS

The most important waveform in TV servicing is the composite signal consisting of the video signal, the blanking pedestals, and sync pulses. Fig. 5 and Fig. 6 show composite signals synchronized with horizontal sync pulses and vertical blanking pulses.

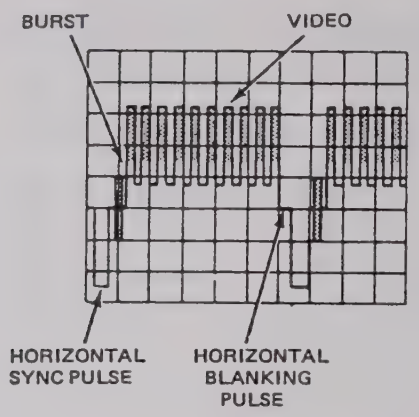


Fig. 5

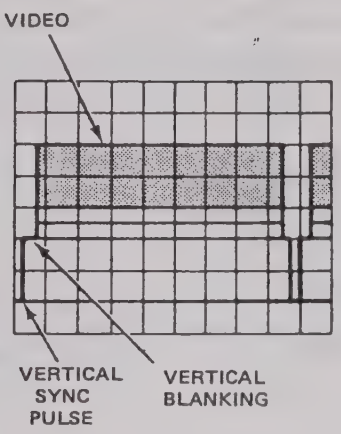


Fig. 6

3-9-(9) MEASUREMENT OF FREQUENCY BY X-Y

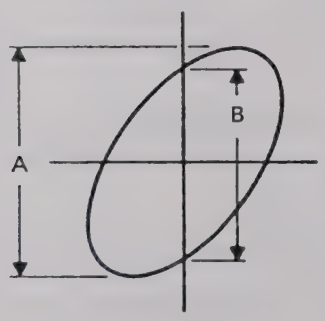
Simply turn SWEEP/DIV switch to CH-B for X-Y operation. Then CH-A becomes Y axis and CH-B X axis. Connect a standard frequency signal to CH-B and unknown signal to CH-A. Lissajous figure is displayed on the screen as shown in Fig. 7.

Standard signal frequency: Unknown signal frequency

Fig. 7

3-9-(10) PHASE MEASUREMENT

In X-Y function, apply two signals to each CH-A and CH-B. Calculate according to the formula.



$$\text{SINE } \phi = \frac{B}{A}$$

ϕ=PHASE ANGLE

Fig. 8

3-9-(11) PHOTOGRAPH

CRT CAMERA (using Polaroid film) exact hood size camera for this oscilloscope is available.

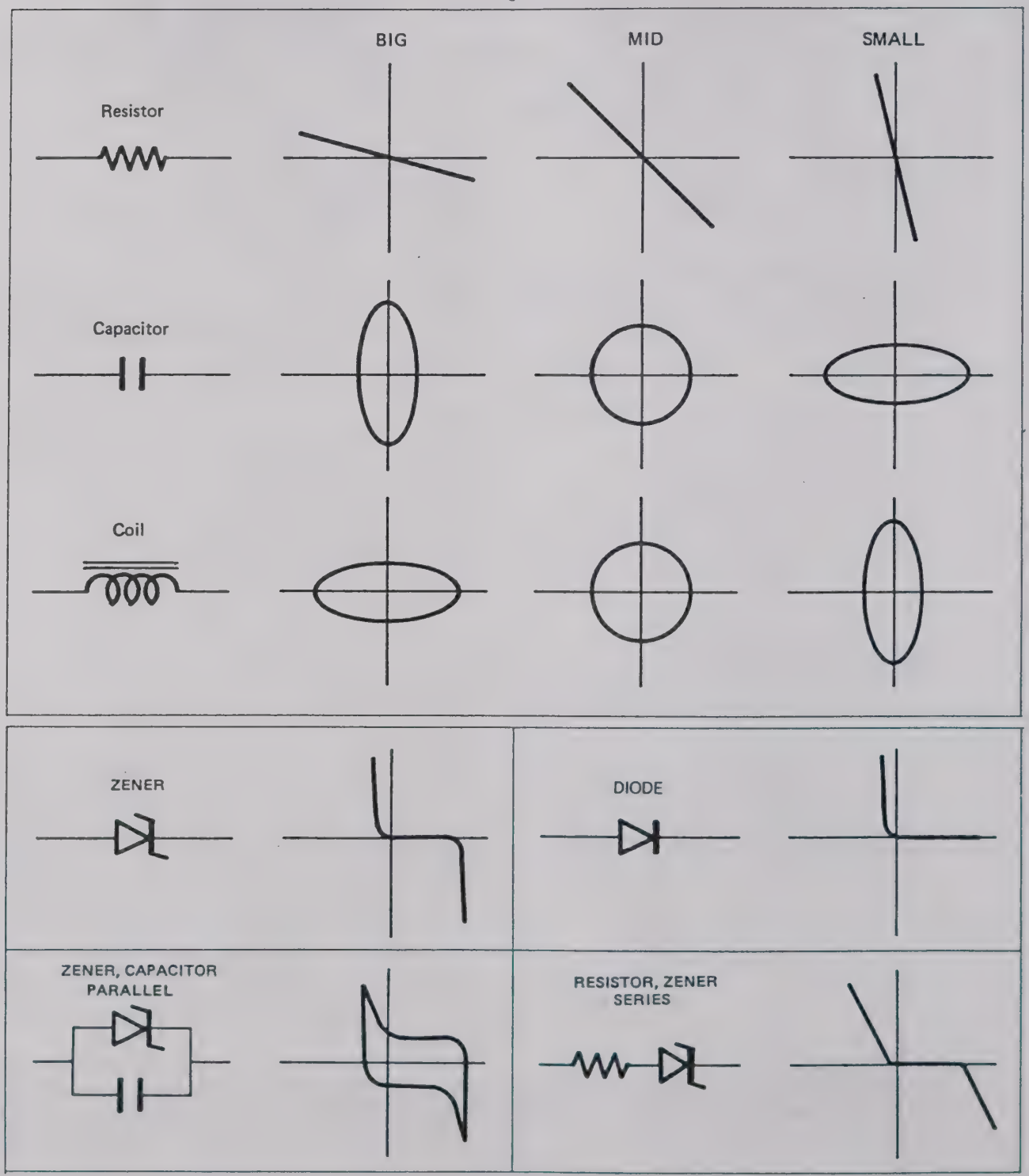
3 -9-(12) COMPONENT TEST

Turn SWEEP TIME/DIV knob to CH-B (clockwise) for X-Y mode and set both AC-GND-DC switches to the GND position as well as setting the both VOLTS/DIV knob CH-A to 2V/DIV, CH-B to 5V/DIV, then push the COMP. TEST SW. Components may be directly hooked to the COMP. TEST IN terminals or though lead wires.

Fig. 9 shows some reference displays.

Note: While in COMPONENT TEST operation, AC 9 VRMS is at the terminal for no load and abont 2 mA will flow when they are shorted.

Fig. 9



4-1 OUTLINES OF CIRCUIT

Block diagram of this model is as Fig. 10.

This oscilloscope is equipped with 2 identical input attenuators and preamplifiers. The input signal is attenuated to the required level, amplified to the preamplifier, and led to the trigger pick off circuit, then to the switching circuit.

At the trigger pick off circuit, a part of the signal is picked up and fed to the trigger select logic for either CH-B, INT (CH-A + CH-B) and led to the trigger amplifier of the TIME BASE Block.

The switching circuit consists of diode-gate and mode control logic to select CH-A, CH-B and DUAL.

After the switching circuit the signal is amplified, and goes through a cascade type final stage amplifier for CRT vertical deflector.

The trigger signal or an external trigger signal is amplified and reformed as a clock pulse to drive the following saw tooth generator circuit, which consists of JKRS flip-flops and sweep controler, FET input Miller integrator, hold-off.

The tooth wave generated by the clock pulse, is led to a differential amplifier which, is equipped with a stabilized current supply, then fed to CRT horizontal deflector.
For X-Y operation, CH-B input signal is led to the pick-off circuit, sweep X-Y selector, then horizontal final amplifier.

Q signal in the sweep control flip-flop and NAND of chopper rising edges are used for unblanking and chop-blanking. It is led to a cascade amplifier with a constant current load, a DC producing circuit and then added on to a high voltage, and then fed between the control grid and cathode of the CRT. The CRT is cut off during trace fly-back, and while waiting for trigger and chop change over time.

The power supplies are all regulated.

A feed back type DC-DC converter is used for generating the stabilized high voltage to CRT.

4-2 VERTICAL AMPLIFIER CIRCUIT

The vertical input signal fed from the BNC input terminal is controlled by the AC-GND-DC switch and applied to the lst attenuator, where 1/10 step (20dB) attenuation takes place. The out of input protection circuit Q1 (Q25) is fed to the DUAL FET through high input impedance. DUAL FET is well DC balanced against temperature variation. The output is then applied to the 2nd attenuator composed of 1C1 (1C2). The 2nd attenuator makes the selection of 1/1, 1/2, 1/4 steps, modifying gain of 1C1 (1C2). After being DC balanced, through VR1, 3, 4 (VR7, 9, 10), the output signal is fed to the diode switching circuit composed of D2-5, 16-19 as well as to the trigger amplifier made of Q7, 8, 31, 32.

The mode logic circuit which is controlled by the MODE switch, makes the selection of dual-trace, single-trace, CHOP and ALT possible. Dual-trace operation is obtained by the trigger select logic circuit driven by TRIG SOURCE switch, while the vertical MODE switch works prior to TRIG SOURCE switch and selects a proper trigger signal for single-trace operation.

In single trace operation triggering is automatically logic controlled according to the vertical MODE switch prior to Trigger SOURCE Selector.

In X-Y operation, controlled by the SWEEP TIME/DIV control, CH-B signal is supplied to the trigger amplifier and fed to the horizontal amplifier as the X signal.

The vertical signal through diode switching circuit passes the limiter circuit of Q11, 12 and D6-9 to obtain the adequate level, and then is fed to the output amplifier composed of Q15-24. The output obtained is sufficiently amplified by the feedback-type amplifier with the constant current circuit (Q19, 20, 23, 24). This amplifier is equipped with the booster (Q21, 22) for high frequency contents to obtain flat response signals. The signal is then fed to the vertical deflection plates of CRT.

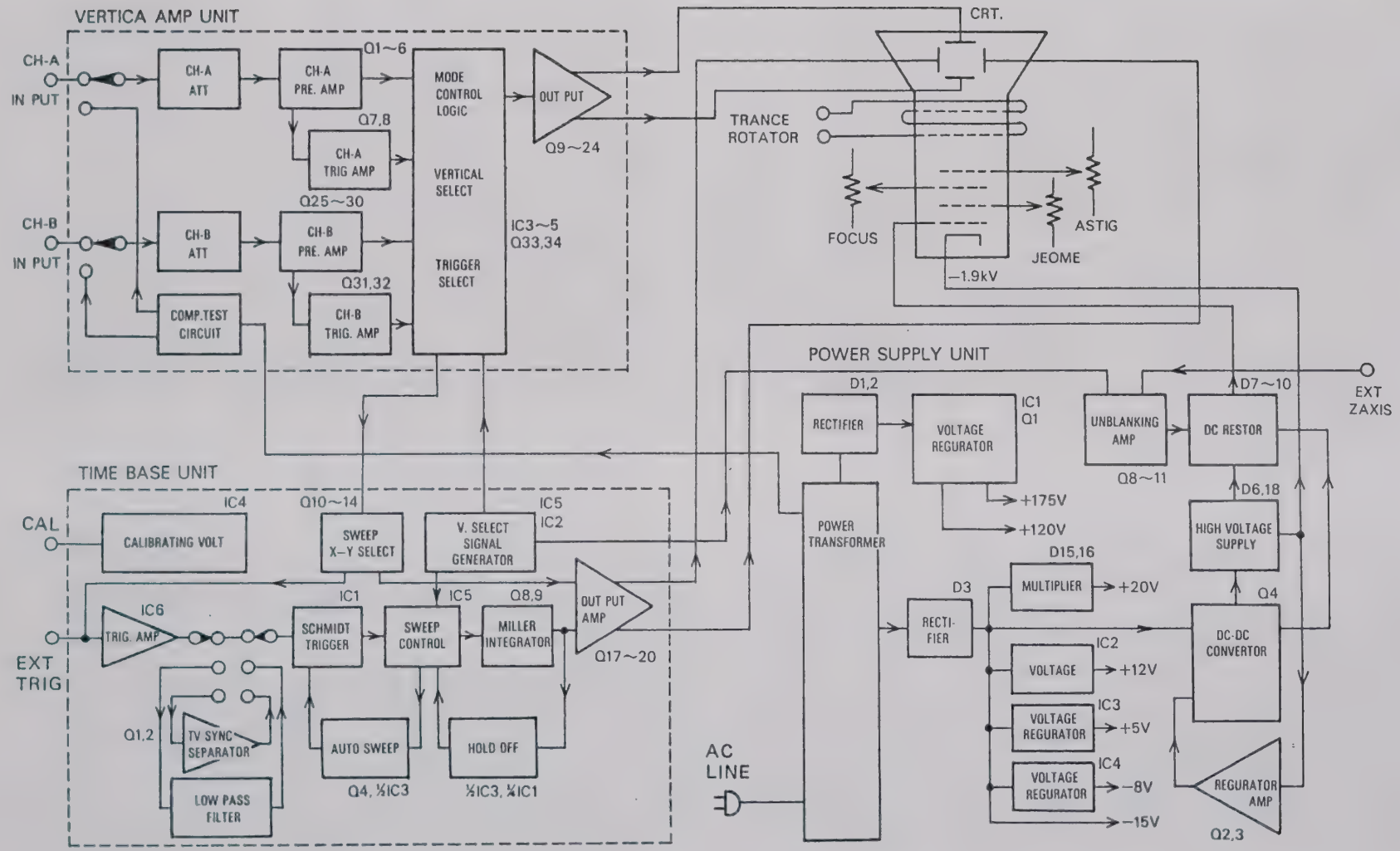

VERTICA AMP UNIT
CH-A
IN PUT
CH-A ATT
CH-A PRE. AMP
Q1~6
Q7,8
CH-A TRIG AMP
MODE CONTROL LOGIC
VERTICAL SELECT
TRIGGER SELECT
IC3~5
Q33,34
OUT PUT
Q9~24
CH-B
IN PUT
CH-B ATT
CH-B PRE. AMP
Q25~30
Q31,32
CH-B TRIG. AMP
COMP.TEST CIRCUIT
CRT.
TRANCE ROTATOR
FOCUS
ASTIG
JEOME
-1.9kV
POWER SUPPLY UNIT
D1,2
RECTIFIER
VOLTAGE REGURATOR
IC1
Q1
+175V
+120V
UNBLANKING AMP
Q8~11
DC RESTOR
D7~10
EXT ZAXIS
D6,18
HIGH VOLTAGE SUPPLY
Q4
DC-DC CONVERTOR
REGURATOR AMP
Q2,3
POWER TRANSFORMER
D3
RECTI-FIER
D15,16
MULTIPLIER
+20V
IC2
VOLTAGE
+12V
IC3
VOLTAGE REGURATOR
+5V
IC4
VOLTAGE REGURATOR
-8V
-15V
AC LINE
TIME BASE UNIT
CAL
IC4
CALIBRATING VOLT
Q10~14
SWEEP X-Y SELECT
IC5
IC2
V. SELECT SIGNAL GENERATOR
IC6
TRIG. AMP
EXT TRIG
IC1
SCHMIDT TRIGGER
IC5
SWEEP CONTROL
Q8,9
MILLER INTEGRATOR
OUT PUT AMP
Q17~20
Q1,2
TV SYNC SEPARATOR
LOW PASS FILTER
AUTO SWEEP
Q4, ½IC3
HOLD OFF
½IC3, ½IC1

Fig. 10

4-3 HORIZONTAL/TIME BASE CIRCUIT

Time Base circuit consists of trigger section, the saw-tooth section and amplifier section. The output from trigger select circuit is led to sweep X-Y select circuit (Q11~14). This select circuit works as the internal trigger amplifier and the saw-tooth wave amplifier in normal operation, and as the amplifier for CH-B signal in X-Y operation. The internal trigger signal is being amplified by 1C6 and then fed to schmidt circuit (1/2 IC1). The external trigger signal is directly fed to IC6. With TRIG SOURCE switch set to HF REJ, noises and high frequency components in the trigger source are eliminated. With TRIG SOURCE switch set to TV, IC output is connected to TV sync separator (Q1,2) to obtain horizontal sync signal (TVH) or vertical sync signal (TVV) and to supply it to schmidt circuit. Changeover between TVH and TVV is automatically accomplished by the SWEEP TIME/DIV switch. The signal in the schmidt trigger circuit is shaped into square waves and becomes clock pulses for sweep control gate (IC5). The clock pulse is also supplied to auto sweep (Q4, 1/2 IC3). With no trigger input, the output of the auto sweep circuit becomes low level, and therefore sweep control gate starts automatic sweeping. With triggering input, or supply of clock pulse, the output of auto sweep circuit becomes high level and the gate F.F. is inverted by the clock pulses and the Miller integrator becomes charged. Also, the output of auto-circuit actuates Q23 ON/OFF. When the gate F.F. is inverted, and sets Q7 to OFF, the Miller integrator determines the sweep time by the C/R time constant selected by the SWEEP TIME/DIV switch to obtain saw-tooth waves of excellent linearity. When the output from the Miller integrator fully rises, the Hold-off F.F. is inverted and the sweep stops for the time detemined by the Hold-off time constant. When the Hold-off time passes, the next clock pulse is set in standby mode and thereby the sweep returns to the original status.

The output of this Miller integrator passes through sweep X-Y select circuit and is fed to the horizontal amplifier (Q17~20). In this amplifier, by use MAG X5 switch, sweep time is expanded by factor of 5. With SWEEP TIME/DIV switch set to X-Y position, sweep X-Y select circuit is switched to separate the Miller integrator from the horizontal amplifier and then the vertical CH-B input is applied as horizontal input amplifier. In CHOP operation, blanking effects are given with the use of the horizontal Q output and CHOP signal generator. In ALT operation, the effects are given by Q output.

The output from multivibrator of IC4 is shaped to obtain the calibrating voltage output. The variable resistor of VR5 is used to adjust the output level of 0.5p-p.

5-1 GENERAL

This section contains information for preventive maintenance, adjustment and calibration.

5-1-(1) PREVENTIVE MAINTENANCE

Preventive maintenance consists of periodic cleaning, and recalibration of the oscilloscope. It should be performed on a regular bases to keep the instrument in its best operational and appearance condition.

5-1-(2) CLEANING

Accumulation of dirt, dust and grime should be removed whenever they become noticeable. The frequency of cleaning is largely dependent upon the environment in which the instrument is used. Dirt on the outside covers may by removed with a soft cloth moistened with a diluted household cleaning solution.

5-1-(3) RECALIBRATION

Recalibration of the instrument at regular intervals will assure that measurements within the accuracy specification. It is recommended that the instrument be recalibrated after 1000 hours of operation, or twice a year. The calibration procedures are provided in the latter part of this section of the manual.

5-2 ADJUSTMENT AND CALIBRATION

Most of the problems resulting in a malfunction will be a defective component or a mechanical defect. Verify that the problem is not due to an incorrect switch position. The CRT display can be a valuable aid in pinpointing the area of many problems. The defect of any of the amplifiers, triggering circuit will be noticeable on the CRT.

Test Instruments Required

Instrument	Brief Specification
1. Digital Voltmeter	Range : 0 to 1000V DC Accuracy : Within 0.5%
2. 10 : 1 High Voltage Divider	± 2%
3. Square wave generator	1KHz ~ 1MHz, Resetime < 5nS
4. Oscillator	1KHz ~ over 20MHz
5. Time Mark Generator	Pulse ranges from 0.1μs to 0.5mS ± 1%
6. Cable	Male BNC to male BNC, 50Ω

5-2-1 PRELIMINARY PROCEDURE

1. check that the 100V/117V/220V/240V/ and Voltage selector is properly set.
2. turn the instrument on and allow at least 20 minutes warm-up before starting the adjustment procedure. For the best overall accuracy, make adjustments in ambient temperature of +20°C to +30°C.

5-2-2 POWER SUPPLY UNIT ADJUSTMENTS

Some problems may result severe loading on the power supplies. The power supply unit for the this model comprises a DC to DC converter. The normal operating frequency of the converter is approximately 40KHz. Modifying pulse width with the change of loads, this converter assures the constant voltage supply. When the secondary voltage of the converter is incorrect, remove the P4 and P7 connectors of the Power Supply unit for checking.

1. Voltage Adjustments
   a) Connect Digital Voltmeter common (or -) lead to the 5th pin on connector P4 (or ground)
   b) Connect Digital Voltmeter V. Ω (or +) lead to the 1st Pin on connector)P4.
   c) Adjust VR6 until + 200V supply gives reading of +200V ±0.5V.

d) Transfer Digital Voltmeter V. Ω (or +) lead to the 2nd pin on connector P7.
e) Adjust VR1 for Digital Voltmeter reading of -1.9 KV ±5V.
f) Disconnect Digital Voltmeter.

2. Adjustments of intensity limit, Astingmatism, Trace Alignments.
a) Set Time/Div. switch to CH B position.
b) Center beam using Position (↕).
c) Rotate Intensity to 10 o'clock position.
d) Adjust VR5 (intensity limit adjustment) so beam is just extinguished.
e) Adjust INTENSITY to obtain normal spot brightness and FOCUS to center position.
f) Adjust Astingmatism adjustment, VR3 and jeome adjustment, VR4 to get a sharp, round dot.
g) Set TIME/DIV. switch to 0.5μs position.
h) when fly-back line appears on the CRT with trace line, adjust VR2 until the fly-back line is minimized.
i) repeat step a to f
j) Adjust trace rotator so that trace is parallel with horizontal graticule lines. Local magnetic field affects this setting.

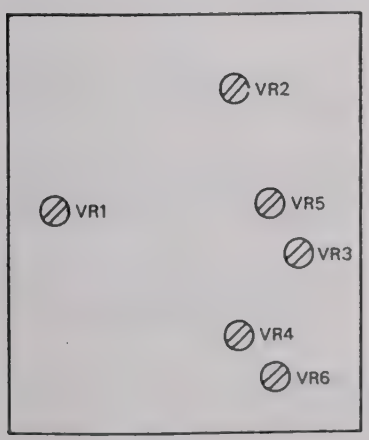


Fig. 12
POWER SUPPLY UNIT
290-1017-33

5-2-3 VERTICAL AMPLIFIER UNIT ADJUSTMENTS

1. Adjustments of preamplifier

   a) Preliminary control setting : preset front panel controls as follows:

Intensity	Midrange
Focus	Midrange
Vertical Mode	CH A
Volts/Div. (both)	10mV
AC-GND-DC (both)	GND
Variable	Detent
Time/Div.	0.5mS
Source	INT
SYNC	NORM +
Level	Midrange and pull auto
Position (All)	Midrange

   b) short TP terminal of V-PCB.
   c) Adjust VR6 so that sweep lines could be at the center of CRT.
   d) open TP terminal
   e) Use CH A Position (↕) control to set trace on center horizontal graticule line.
   f) Adjust VR1 (VR7 for CH B) for no trace shift while switching CH A Volts/Div control between 2mV and 10mV.
   g) Adjust VR3 (VR9 for CH B) until no trace shift occurs when CH A Variable move between minimum and maximum.
   h) Rotate CH A Position (↕) to 12 o'clock position and adjust VR4 (VR10 for CH B) so that sweep lines could be at the center of CRT.
   i) Repeat steps e) through h) for CH B.

2. Adjustments of attenuator

   a) Set CH A Volts/Div switch to 0.1V setting and Time/Div switch to 20μs setting.
   b) Set vertical Mode switch to CH A
   c) Connect square-wave generator (600Ω output) to CH A input connector.
   d) Set square-wave generator control for 1 KHz output with sufficient amplitude to produce 6 divisions of vertical deflection.
   e) Adjust TC1 (TC7 for CH B) compensation adjustments to achieve squarest corners on the displayed waveform.
   f) Set square wave generator for 1KHz signal 6 divisions of vertical deflection.
   g) Adjust input capacitor adjustment TC2 (TC8 for CH B) for best possible waveform.
   h) Set Volts/Div switch to 1V settings. Adjust square wave generator output for 1 KHz and 6 divisions of vertical deflection.
   i) Adjust TC3 (TC9 for CH B) compensation adjustment to achieve squarest corners on displayed waveform.
   j) Set square wave generator controls for 1KHz output with sufficient amplitude to produce 6 divisions of vertical deflection.
   k) Adjust input capacitors TC4 (TC10 for CH B) for best possible wave form.
   l) Set Volts/Div switch to 10V settings. Adjust square wave generator output for 1 KHz and 6 divisions of vertical displays.
   m) Adjust TC5 (TC11 for CH B) compensation adjustment to achieve squarest corners on displayed waveform.
   n) Set square wave generator control for 1KHz output with sufficient amplitude to produce 6 division of verticle deflection.
   o) Adjust input capacitors TC6 (TC12 for CH B) for best possible waveform.
   p) Repeat steps a through O for CH B.
   q) Setting

Volts/Div (both)	0.1V
CH A AC-GND-DC	DC
CH B AC-GND-DC	GND
Verticle Mode	CH A
Time/Div	1μS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

r) Adjust square wave generator output for 100KHz and 6 division of verticle display.

s) Adjust TC13 until squarest waveform.

t) Adjust C11 (CH-A) and C50 (CH-B) until squarest waveform for over shoot and under shoot.

u) Adjust VR13 until no waveform distortion occurs when position (↕) control between up and down.

3. Adjustment of Vertical gain

a) Setting

Volts/Div (both)	2mV
Vertical Mode	CH A
AC-GND-DC (both)	DC
Time/Div	0.5mS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

b) Connect Oscillator to CH A input connector.

c) Set Oscillator for 1KHz at exactly 10mV p-p Amplitude.

d) Adjust Verticle gain adjustment VR5 (VR11 for CH B) for exactly 5 divisions of verticle deflection. This ensures 3% accuracy in the vertical amplifier.

e) Set vertical Mode to CH B.

f) Repeat steps b) through d) for CH B.

g) Set Time/Div. switch to CH B position and CH B Volts/Div switch to20mVsetting. Center beam using position (↕) controls.

h) Connect Oscillator to CH B input connector and Set Oscillator for 1KHz at exactly 10mV P-P amplitude.

i) Adjust VR 12 for exactly 5 divisions of horizontal deflection.

j) Disconnect Oscillator.

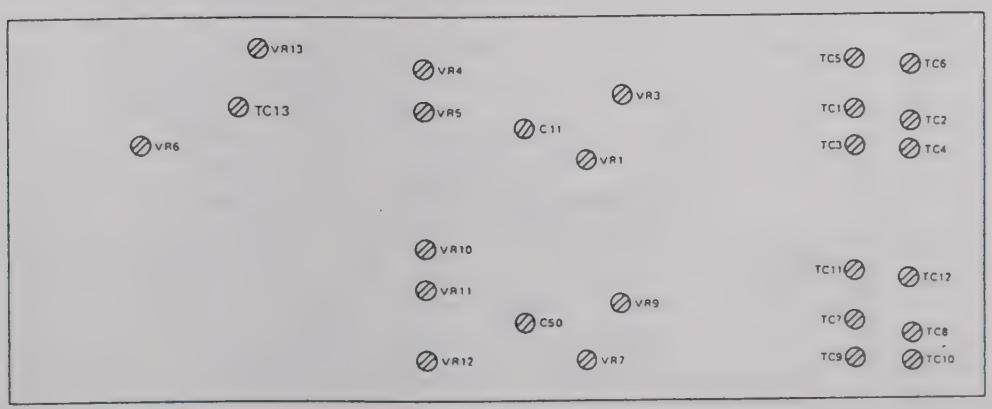


Fig. 13
VERTICAL AMPLIFIER UNIT
290-1016-34

5-2-4 Horizontal/Time Base Unit Adjustments.

1. Adjustment of Sweep Time/Div.
   a) setting.

Volts/Div (both)	0.1mV
Vertical Mode	CH A
Time/Div	0.1mS
Source	INT
SYNC	NORM +
Level	Midrange and Pull Auto

   b) Connect Time marker generator to CH A input connector and set generator for 0.1mS marker interval.
   c) Adjust VR8 so that lie on vertical graticule lines.
   d) Set generator for 1μS marker interval and 620C sweep to 1μS.
   e) Adjust TC2 so that time marker again co-incide with vertical line of graticule.
   f) Set generator for a 0.5μS marker interval and Time/Div switch to 0.5μS settings.
   g) Adjust TC1 so that markers lie on Vertical graticule and adjust VR14 for realignment of the range of 0.2μS/Div.
   h) Set Time/Div switch to 0.1mS setting and set generator for a 0.1mS marker interval.
   i) Set 5 X MAG switch to pull.
   j) Adjust VR12 for exactly 5 divisions fo horizontal deflection and then push MAG switch.
   k) Adjust VR7 to obtain the same center position when the display is magnified.
   l) Adjust of sweep linearity: Adjust VR10 so that sine wave could not be concentrated at one side under time 0.1mS/Div.
   m) Adjustment of triggering: Adjust VR5 so that both (Sync + or −) start at the same point.

2. ADJUSTMENT OF X-AXIS (CH-B) POSITION . . . . . With SWEEP TIME/DIV. control set at CH-B, check if shift range is balanced when X-axis POSITION (CH-B VERTICAL POSITION) is turned. If there is unbalance, Adjust VR9 and then Adjust VR11 to be at the center of X-axis.

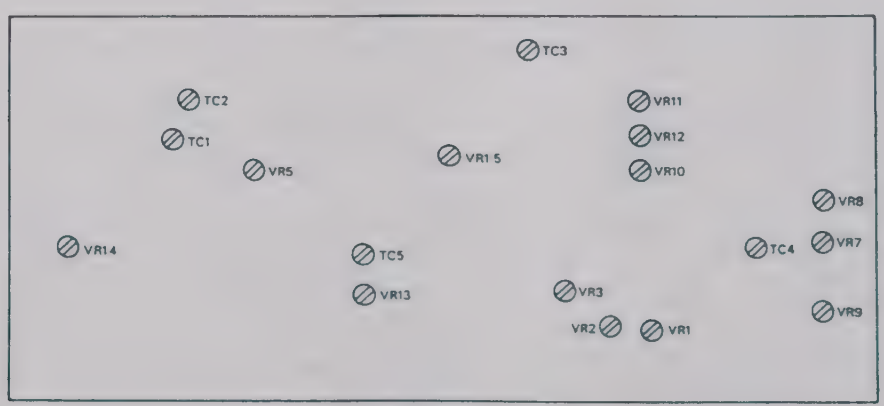
3. ADJUSTMENT OF TRACE LINE LENGTH . . . . . Adjust VR13 to obtain the length of 11DIV on CRT screen.

4. ADJUST VR1 VR2 AND VR3 for CALIBRATION ·· To be 0.5V P-P when 1:1 probe is connected to the terminal of front panel calibration under VOLT/DIV 0.1V and TIME/DIV 0.1ms

5. ADJUST TC5 FOR 0.5 sec LENGTH ····· The length of trace line could be reached on the CRT surface when you input 0.5μs pulse under TIME/DIV 0.5μs range.

6. ADJUST TC4 FOR 0.5 sec /DIV MAG LINEARITY····· Same as 3. adjustment after you draw PULL 5×MAG SWITCH

7. Adjust VR15 for jittering.
8. Adjust TC3 for unblanking start position.



FOIL SIDE VIEW

CALIBRATION LOCATIONS FOR HORIZONTAL/TIME BASE UNIT

290-1004-14

6-1 CHASSIS (700-1110-00)

REF. NO.	PARTS NO.	DESCRIPTION	
	100-1020-03	Case Top	
	100-1021-03	Case Bottom	
	118-1016-12	Ormanental Panel	
	150-1001-04	Side Eacutcheon	
	126-1008-02	Rear Panel	
	140-1033-03	Frame (A)	
	140-1034-03	Frame (B)	
	140-1035-03	Frame (C)	
	140-1036-03	Frame (D)	
	140-1037-03	Frame (E)	
	140-1038-03	Side Frame (right)	
	140-1039-03	Side Frame (left)	
	160-1014-04	P.T. Holder Plate	
	160-1015-03	CRT Holder	
	160-1013-04	VR Mounting Metal	
	160-1017-04	Metal Mount for Slide SW	
	200-1000-03	CAL Terminal	
		GND Terminal	
		Moulded Terminal	
	288-1005-05	AC INNET Ass'y	
	215-1000-05	CRT Socket	
	235-1000-04	Mould Bearing	
	255-1006-03	CRT Band (A)	
	255-1007-03	CRT Band (B)	
	260-1000-05	BNC Receptacle	
	330-1002-04	Shield Plate	
	330-1032-04	Shield Plate (A)	
	400-1002-05	Handle	
	405-1002-05	Rubber Leg	
	405-1004-03	Moulded Leg	
	405-1005-03	Stand	
	415-1002-03	Bezel	
	420-1017-04	Knob for T. Position, V. Position x 2, Iten, Focus, Trig Level	
	420-1030-04	Knob for T. Rotary SW	
	420-1012-04	Knob for T. Variable, V. Variable x 2	
	420-1029-04	Knob for AC-GND-DC x 2, Slope, Sync, Source, Mode	
	420-1018-04	Knob for Comp Test SW	
	420-1016-04	Knob for V. Rotary SW x 2	
	430-1000-04	CRT Screen Filter	
	002-1000-05	Potentiometer	1kΩ
	002-1001-05	"	20kΩ
	002-1017-05	"	2MΩ
	002-1007-05	"	1kΩ
	002-1012-05	"	50kΩ
	002-1016-05	"	50kΩ
	020-1006-05	Slide Switch	
	024-1004-05	Push Switch	
	026-1000-05	Toggle Switch	
	040-1007-05	Power Transformer	
	050-1003-05	Rotation Coil	
	080-1002-05	Fuse	1A
	080-1004-05	"	0.5A
		CRT	
		LED	
		LED Holder	

6-2 VERTICAL AMPLIFIER UNIT (290-1016-34)

REF. NO.	PARTS NO.	DESCRIPTION			
S1,2	018-1005-05	Rotary Switch			
S3	022-1009-05	Lever Switch			
VR2,8	002-1004-05	Potentiometer	5kΩ		
IC1,2	HA1127G	Linear IC	(CA3046)		
IC5	SN74LS03N	IC (LSTTL)			
IC3	CD4001B	" (C2MOS)	(MC14001B)		
IC4	CD4011B	" (")	(MC14011B)		
Q2,26	2SK228T	Dual FET			
Q1, 25	2SK30A (O)	"			
Q19, 20	2SA1144 (Y)	Transistor			
Q17, 18	2SC2704(Y)	"			
Q7, 8, 12, 13, 14, 31, 32	2SA836 (D)	"			
Q11, 15, 16, 23, 24, 33, 34	2SC458 (D or E)	"			
Q3, 4, 5, 6, 9, 10, 27, 28, 29, 30	2SC535 (B)	"			
Q21, 22	2SA781 (K)	"			
D1-9, 11, 15-24	1S1588	Diode			
D10, 14	HZ5C2	Zener Diode			
VR3, 5, 9, 11, 12	008-1004-05	Potentiometer	100ΩB		
VR1, 7, 13	008-1006-05	"	1kΩB		
VR6	008-1007-05	"	470kΩB		
VR4, 10	008-1013-05	"	680ΩB		
TC1, 3, 5, 7, 9, 11		Trimmer	4pF		
TC2, 4, 6, 8, 10, 12, 13		"	10pF		
R8, 112	RN14BK2H1004F	Metal Film Resistor	1MΩ	±1%	1/2W
R6, 110	" 9993F	"	999kΩ	"	"
R4, 108	" 9903F	"	990kΩ	"	"
R2, 106	" 9003F	"	900kΩ	"	"
R3, 107	RN14BK2E1113F	"	111kΩ	"	1/4W
R78, 82	" 1003F	"	100kΩ	"	"
R80	" 4302F	"	43kΩ	"	"
R36, 37, 139, 140	" 1202F	"	12kΩ	"	"
R5, 109	" 1012F	"	10.1kΩ	"	"
R21, 22, 125, 126	" 8201F	"	8.2kΩ	"	"
R12, 13, 116, 117	" 6801F	"	6.8kΩ	"	"
R64, 66, 71	" 4701F	"	4.7kΩ	"	"
R63	" 3301F	"	3.3kΩ	"	"
R44, 45, 149, 150	" 3001F	"	3kΩ	"	"
R85, 93	" 2201F	"	2.2kΩ	"	"
R32, 136	RN14BK2E1501F	Metal Film Resistor	1.5kΩ	±1%	1/4W
R7, 23, 57, 60, 111, 127	" 1001F	"	1kΩ	"	"
R24, 129	" 8200F	"	8.2kΩ	"	"
R39, 40, 142, 143	" 6800F	"	6.8kΩ	"	"
R29, 31, 133, 135	" 4700F	"	4.7kΩ	"	"
R35, 138	" 3300F	"	3.3kΩ	"	"
R26, 131	" 2200F	"	2.2kΩ	"	"
R46, 153	" 82ROF	"	82Ω	"	"
C10, 12, 48	CE04W1C220RC2	Electrolytic Capacitor	22μF		16WV
C7, 18, 22, 45, 49, 59, 63	" 1H4R7RC2	"	4.7μF		50WV
C15, 16, 17, 20, 25	" 1H1RORC2	"	1μF		"
C6, 24, 44, 62	DD600BC104Z12V	Ceramic Capacitor	0.1μF		12WV
C27, 32	CQ92M1H103K	Mylar Capacitor	0.01μF	±10%	50WV
C26, 31, 33, 34, 38	CK45E2H103P	Ceramic	0.01μF		500WV
C60	" 1H103P	"	0.01μF		50WV

REF. NO.	PARTS NO.	DESCRIPTION			
C5, 43		Metal Film Capacitor	0.01μF	+10%	600WV
C4, 42	CM93D1H152J	Myca Capacitor	1500pF	+5%	50WV
C2, 40	〃 221J	〃	220pF	〃	〃
C1, 39	〃 330J	〃	33pF	〃	〃
C29, 65, 67	CC45CH1H101J	Ceramic Capacitor	100pF	〃	〃
C61, 36	〃 560J	〃	56pF	〃	〃
C55, 57, 64	〃 470J	〃	47pF		〃
C9, 13, 19, 47, 52	〃 220J	〃	22pF		〃
C35	〃 200J	〃	20pF		〃
C21	〃 150J	〃	15pF		〃
C8, 46, 11, 50	〃 5ROD	〃	5pF		〃
C3, 41	CC45CH2H2ROD	〃	2pF		500WV
C23, 28	〃 1ROD	〃	1pF		〃
C66, 68	CC45CH1H180J	〃	18pF		50WV
L7, 8		Ferri Inductor	470μH		
L1, 2, 3, 4		〃	47μH		
L5, 6		〃	1μH		

6-3 TIME BASE UNIT (290-1020-43)

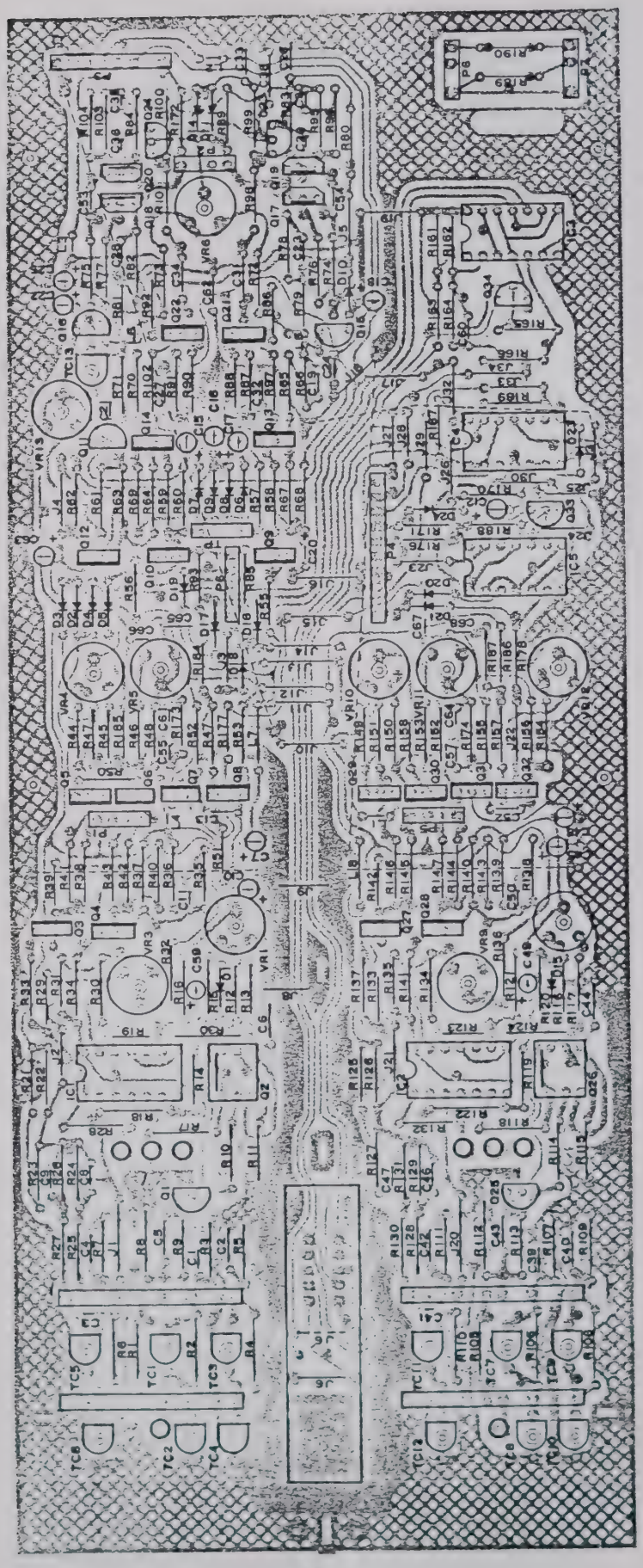
L2		Ferri Inductor			
L3		〃			
L1		〃			
IC6	μA733DC	IC (VIDEO AMP)			
IC1	SN74LS00	IC (LSTTL)			
IC5	SN74LS76	IC (〃)			
IC2	SN7400	IC (TTL)			
IC3, 4	MC14572UB	IC (C2MOS)			
Q8	2SK30A (0)	FET			
Q4, 7, 10, 11, 12, 13, 14, 15	2SA836	Transistor			
Q16, 22, 24	〃	〃			
Q1, 2, 3, 6, 9, 17, 18, 21, 23	2SC458 (D)	〃			
Q15, 16, 25, 26	〃	〃			
Q19, 20	2SC 2704	〃			
D4	IN60	Diode			
D5, 10	IS1587	〃	(IS2076A)		
D1, 2, 3, 6, 7, 8, 9, 13, 14, 15	IS1588	〃	(IS2076)		
D16, 17, 18, 20	〃	〃	〃		
D11, 12	HZ5C2	Zener Diode			
D19	HZ12C2	〃			
VR4, S5	002-1005-05	Potentiometer	20kΩ		
VR6	002-1006-05	〃	10kΩ		
S4	018-1008-05	Rotary Switch			
S1	022-1011-05	Lever Switch			
S2	022-1010-05	〃			
S3	022-1009-05	〃			
VR13, 14	008-1017-05	Potentiometer	100kΩ		
VR1, 2, 5, 7, 8	008-1018-05	〃	50kΩ		
VR9	008-1019-05	〃	20kΩ		
VR3	008-1020-05	〃	5kΩ		
VR11	008-1021-05	〃	200Ω		
VR10	008-1025-05	〃	1 kΩ		
VR12	008-1026-05	〃	500kΩ		
VR15	008-1023-05	〃	10kΩ		
R48	RKS1/4P3MF	Metal Film Resistor	3MΩ	1/4W	±1%
R39, 42, 44	RN14BK2E1003F	〃	100kΩ	〃	〃

REF. NO.	PARTS NO.	DESCRIPTION			
R45	〃 2E3003F9	〃	300kΩ	〃	〃
R46	〃 2H5003F	〃	500kΩ	1/2W	〃
R47	〃 2H1004F	〃	1MΩ	〃	〃
R94, 95	RS14AL3F682G	〃	6,8kΩ	3W	±2%
TC1, 2, 3, 4, 5		Trimmer	10pF		
C19		Metal Film Capacitor	0.47μF	200WV	
C20		〃	0.0047μF		
C5, 15, 23, 30, 31, 33, 45, 13	DD600BC104Z12V	Ceramic Capacitor	0.1μF	12WV	
C51, 52, 53	CEO4W1A331	Electrolytic Capacitor	330μF	10WV	
C50	〃 1C221	〃	220μF	16WV	
C8	〃 1A470	〃	47μF	10WV	
C47, 48, 49	〃 1C220RC2	〃	22μF	16WV	
C41	〃 2E4R7	〃	4.7μF	250WV	
C7, 12, 14, 29, 34	〃 1H1RORC2	〃	1μF	50WV	
C40	CK45E2H103P	Ceramic	0.01μF	500WV	
C4, 18, 35	〃 1H103P	〃	0.01μF	50WV	
C24, 25	〃 1H561M	〃	560pF	〃	
C37, 38	〃 1H471M	〃	470pF	〃	
C26, 42	CC45CH1H221J	〃	220pF	〃	
C28, 43	〃 151J	〃	150pF	〃	
C39	〃 680J	〃	68pF	〃	
C1, 17, 27	〃 470J	〃	47pF	〃	
C21	〃 390J	〃	39pF	〃	
C10	〃 221J	〃	220pF	〃	
C22	〃 150J	〃	15pF	〃	
C44	〃 120J	〃	12pF	〃	
C11, 16	〃 100J	〃	10pF	〃	
C3	〃 2H5ROD	〃	5pF	500WV	
C32	〃 2H1ROD	〃	1pF	〃	
C6	CQ92M1H104K	Mylar Capacitor	0.1μF	50WV	
C46	〃 1H223K	〃	0.022μF	〃	
C2	〃 1H472K	〃	4700pF	〃	
C9	〃 1H222K	〃	2200pF	〃	
C36	〃 1H102K	〃	1000pF	〃	

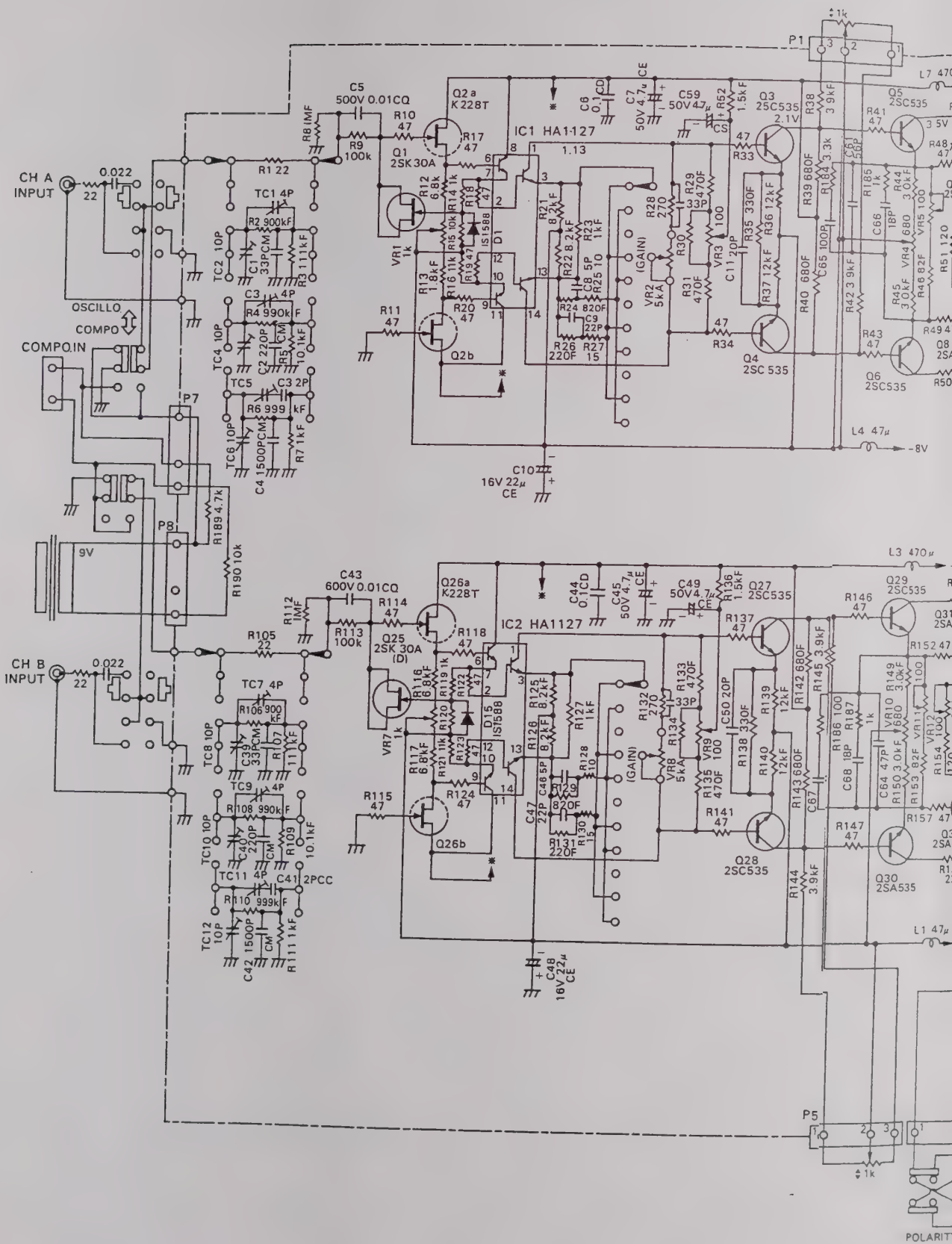
6-4 POWER SUPPLY UNIT (290-1017-33)

F1	080-1003-05	Mini Fuse	0.5A
	225-1000-05	Fuse Holder	
	040-1008-05	Converter Transformer	
L1		Inductor Coil	470μH
L2		〃 〃	4.7μH
VR3, 4	008-1022-05	Potentiometer	1MΩ
VR5	008-1017-05	〃	100kΩ
VR1	008-1018-05	〃	50kΩ
VR2	008-1023-05	〃	10kΩ
VR6	008-1024-05	〃	2kΩ
N1, 2, 3, 4	NE38B	Neon Lamp	
IC1	μA741TC	IC	
IC2	μA8912	〃	
IC3	μA7805	〃	
IC4	μA7908	〃	
IC5	μA78L15	〃	
Q3, 6, 11	2SA836	Transistor	
Q1	2SD596 (D)	〃	
Q2, 5, 10	2SC458 (D)	〃	
Q8, 9, 12	2SC1885	〃	
Q4	2SD401 (K)	〃	

REF. NO.	PARTS NO.	DESCRIPTION			
D1, 2, 3	2W02	Diode			
D6, 18	Y16GA	〃			
D4, 12, 13	1S1588	〃	(1S2076)		
D15, 16	V06C	〃			
D7, 8, 9, 10	1SS83	〃			
D11, 17	HZ5C2	Zener Diode			
D14	HZ4B3	〃			
S1	SDT 1000	Thermister	10kΩ		
(Ordinary carbon resistors are not listed.)					
R6	RN14BK2E4701F	Metal Film Resistor	4.7kΩ	1/4W	±1%
R5	RN14BK2E1203F	〃	120kΩ	〃	〃
R10	RN14BK2E3901	〃	3.9kΩ	〃	〃
C31	CQ92M1H104K	Mylar Capacitor	0.01μF	50WV	
C14	〃 473K	〃	0.047μF	〃	
C39	〃 472K	〃	0.47μF	〃	
C43	〃 222K	〃	0.22μF	〃	
C28	DD600BC104Z12V	Ceramic Capacitor	0.1μF	12WV	
C30	CC45SL2H1ROD	Ceramic	1pF	500WV	
C18, 19, 30, 21, 23, 25, 38	CK45E3D103P	〃	0.01μF	2000WV	
C22, 27, 29, 32	〃 2H103P	〃	〃	500WV	
C16	〃 1H103P	〃	〃	50WV	
C34	〃 2H102P	〃	1000pF	500WV	
C35	〃 1H681M	〃	680pF	50WV	
C7, 10, 42	CE04W1E222	Electrolitic Capacitor	2200μF	25WV	
C8	〃 1E471	〃	470μF	25WV	
C37	〃 1H221	〃	220μF	50WV	
C1,4	〃 2C101	〃	10μF	160WV	
C36	〃 1E331	〃	330μF	25WV	
C3, 40	〃 2E330	〃	33μF	250WV	
C5, 6	〃 2E100	〃	10μF	250WV	
C9, 13, 17, 41	〃 1H1RORC2	〃	1μF	50WV	
C24	〃 2E1RO	〃	1μF	250WV	
	330-1030-03	Shield Case for DC-DC			

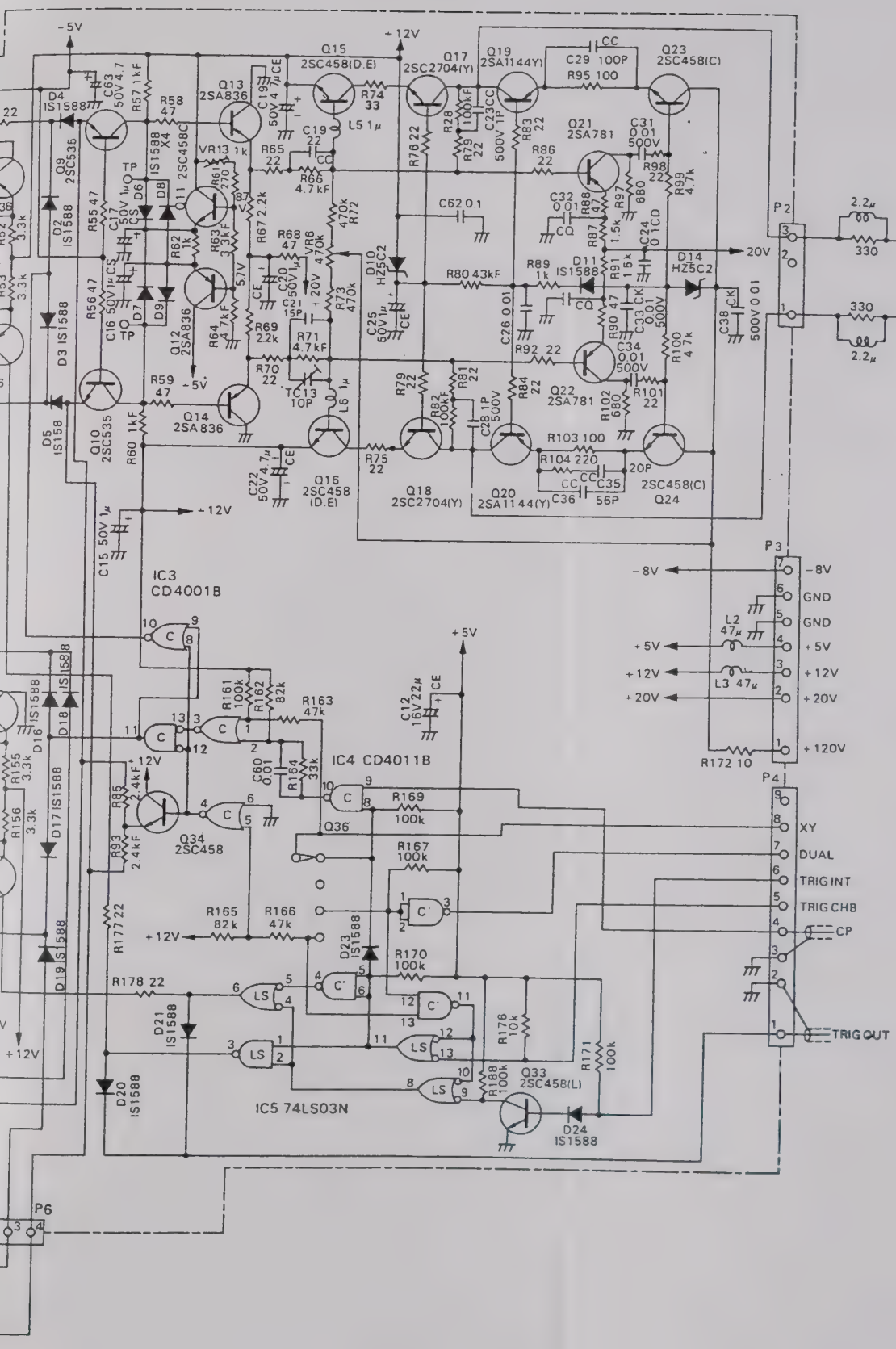


7-1 VERTICAL AMP UNIT

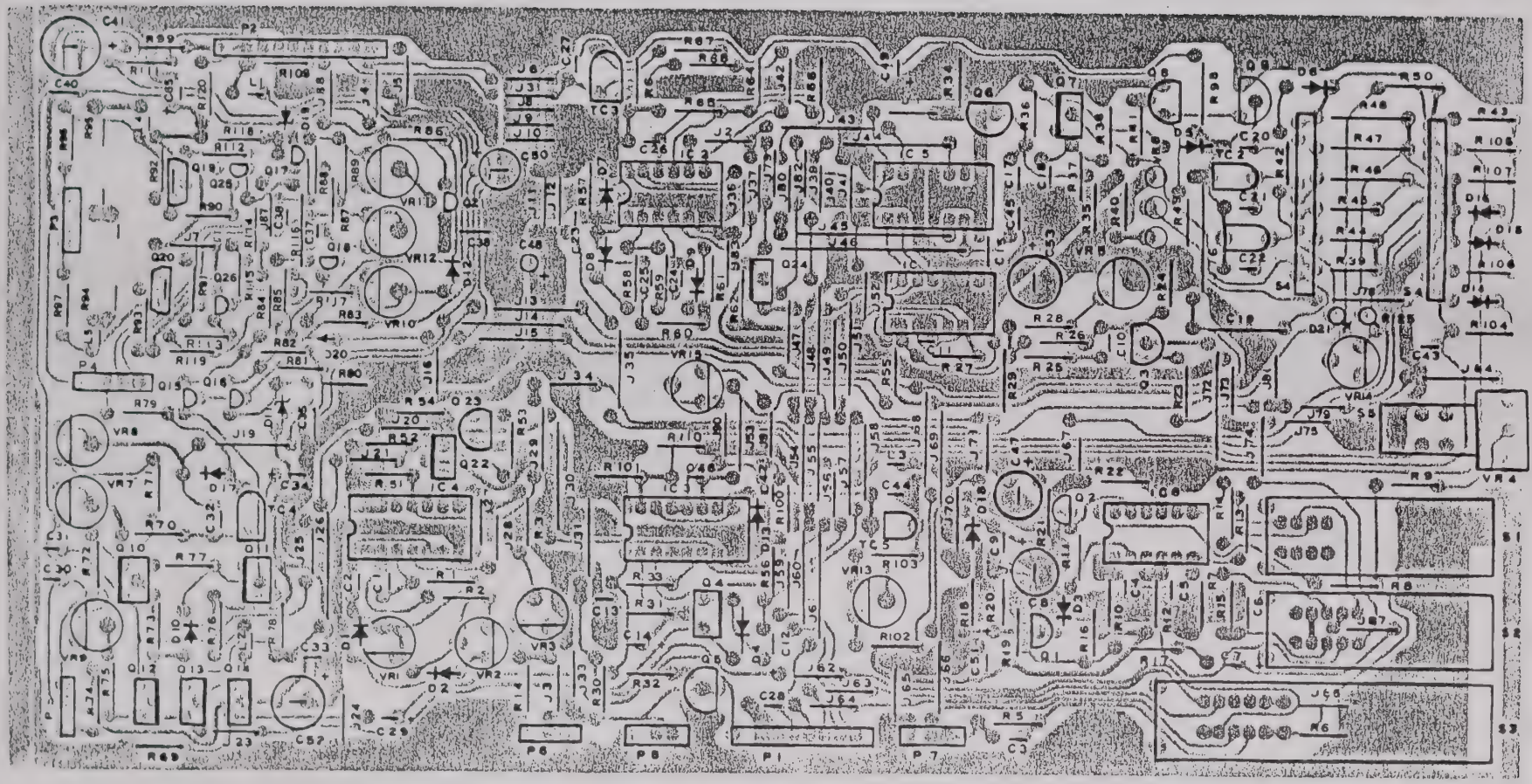


7-1-(1) VERTICAL AMP CIRCU

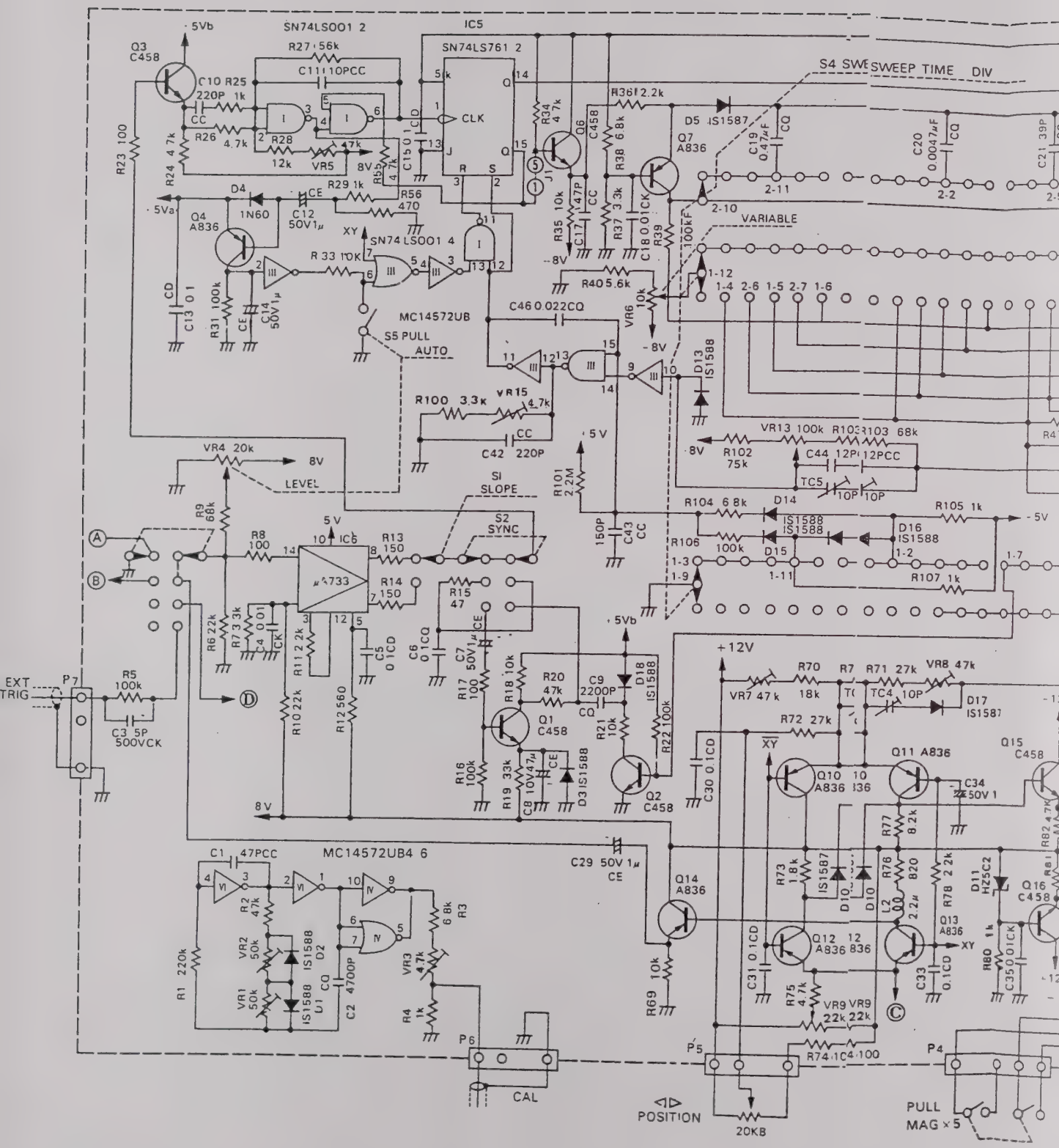
(290-1012-34)


-5V
+12V
Q15 2SC458(D.E)
Q17 2SC2704(Y)
Q19 2SA1144(Y)
Q23 2SC458(C)
Q13 2SA836
Q21 2SA781
Q12 2SA836
Q14 2SA836
Q22 2SA781
Q10 2SC535
Q16 2SC458 (D.E)
Q18 2SC2704(Y)
Q20 2SA1144(Y)
2SC458(C) Q24
D4 IS1588
D11 2SC458C
D10 HZ5C2
D14 HZ5C2
D11 IS1588
D1 IS1588
D2 IS1588
D3 IS1588
D5 IS158
D6 IS1588
D7 IS1588
D8 IS1588
D9 IS1588
D16 IS1588
D17 IS1588
D18 IS1588
D19 IS1588
D20 IS1588
D21 IS1588
D23 IS1588
D24 IS1588
IC3 CD4001B
IC4 CD4011B
IC5 74LS03N
Q34 2SC458
Q33 2SC458(L)
P2
P3
P4
P6
-8V
GND
GND
+5V
+12V
+20V
+120V
XY
DUAL
TRIG INT
TRIG CHB
CP
TRIG OUT
2.2μ
330
330
2.2μ
20V
+5V
+12V
+12V
-5V
+12V
+12V
+5V
+12V
+12V

DIAGRAM

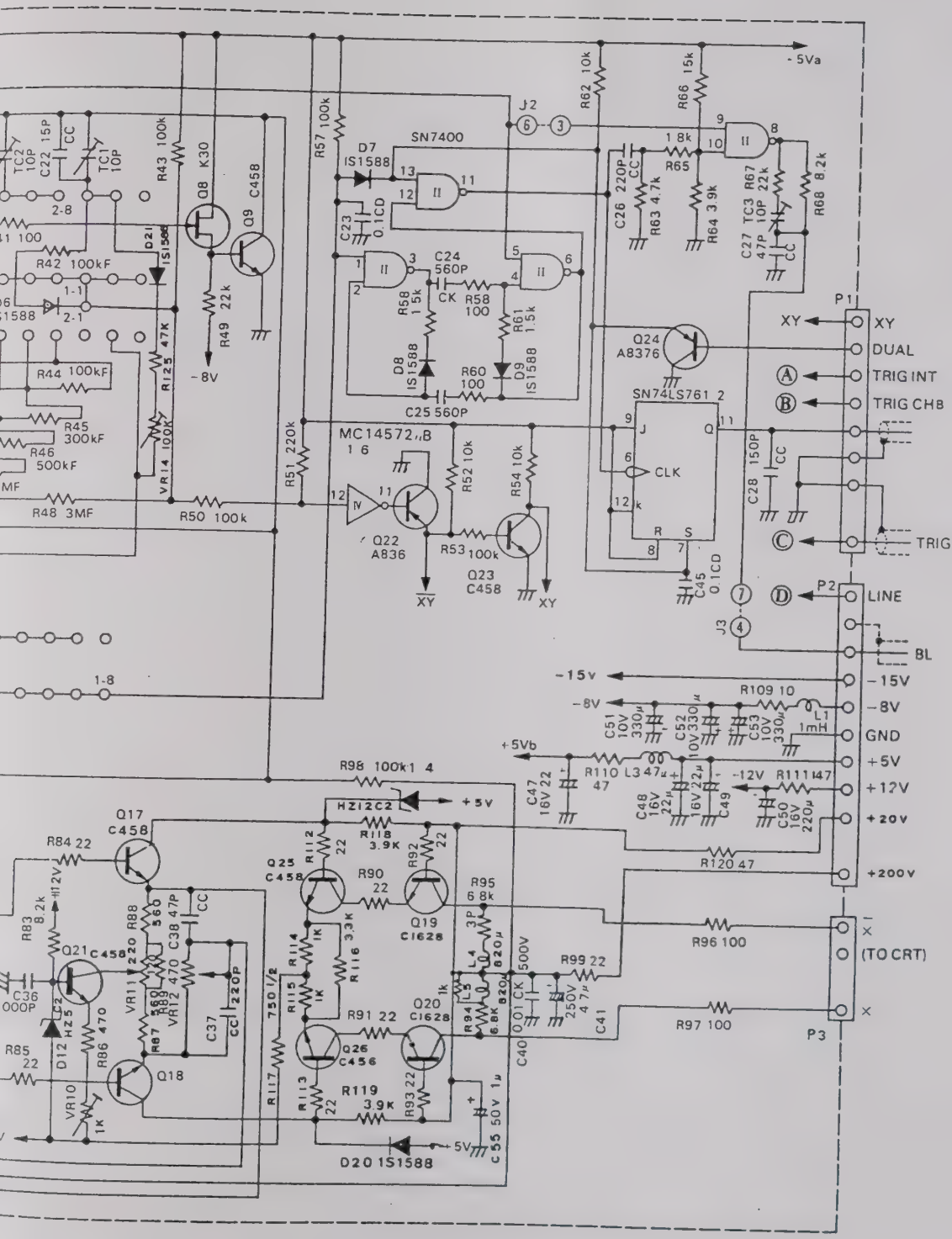


7-2 HORIZONTAL/TIME BASE UNIT

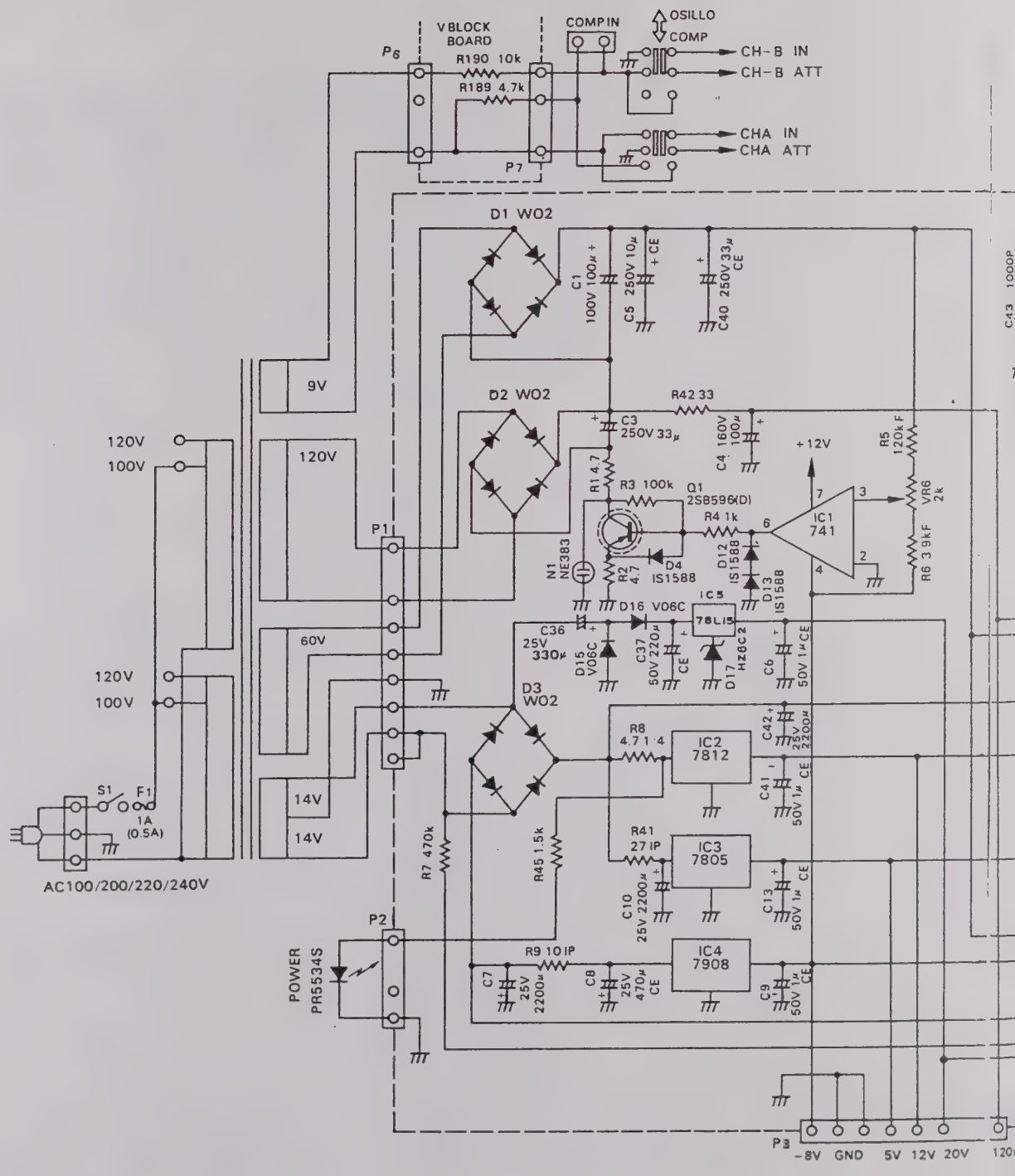


7-2-(1) HORIZONTAL/TIME BASE CIRCUIT

(2 (290-1020-43)

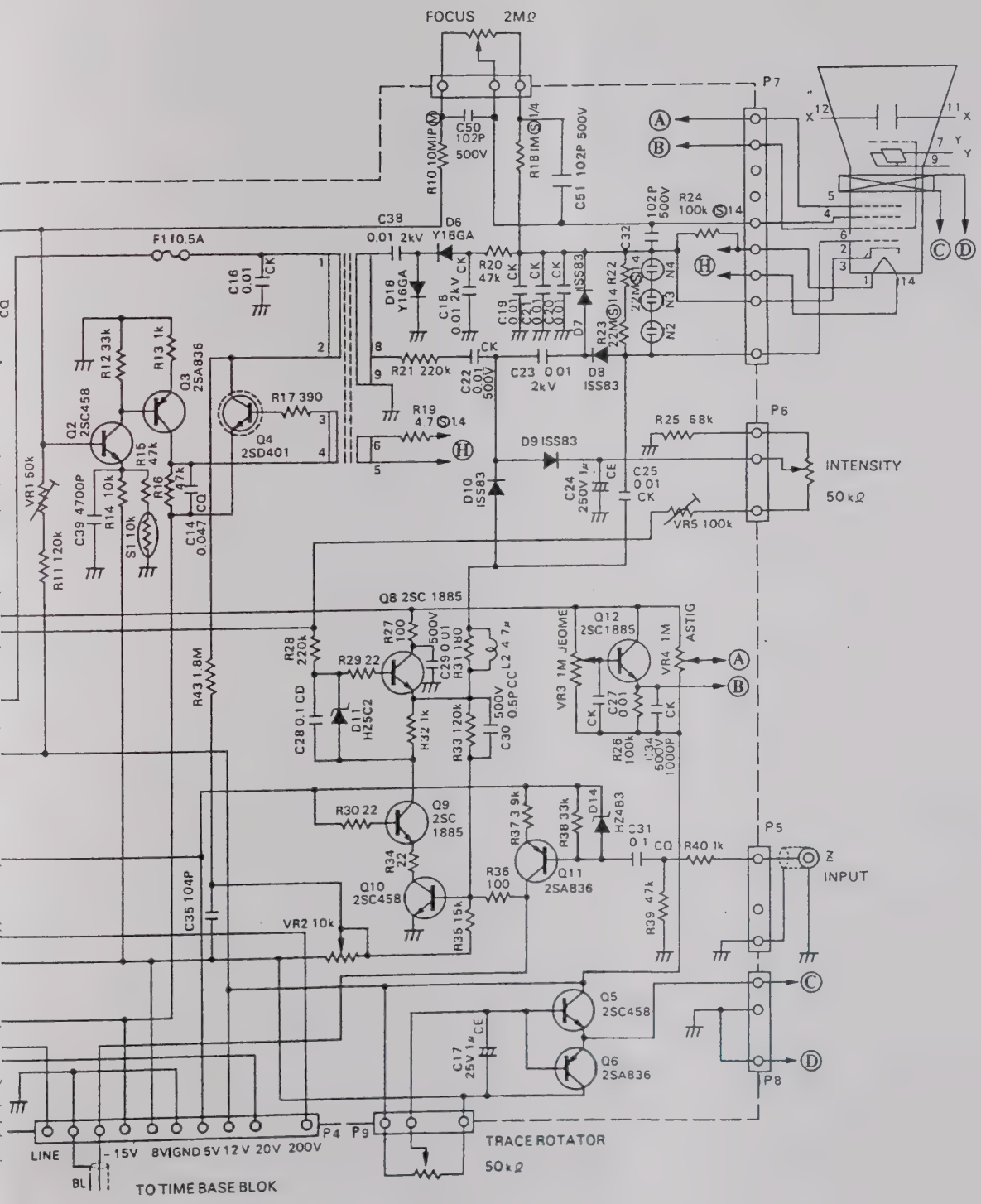

-5Va
SN7400
D7 IS1588
J2
R62 10k
R66 15k
R65 1.8k
R63 4.7k
R64 3.9k
R68 8.2k
C26 220P
C27 TC3 47P 10P 22k
R57 100k
C23 0.1CD
C24 560P
R58 1.5k
R58 100
R61 1.5k
D8 IS1588
D9 IS1588
R60 100
C25 560P
P1
XY
DUAL
TRIG INT
TRIG CHB
TRIG
Q24 A8376
SN74LS761 2
CLK
C28 150P
C45 0.1CD
P2
LINE
BL
J3
-15v
-8V
GND
+5V
+12V
+20v
+200v
R109 10
C51 10V 330µ
C52 10V 330µ
C53 10V 330µ
1mH L1
R110 L3 47µ
47
C47 16V 22
C48 16V 22µ
C49 16V 22µ
C50 16V 220µ
R111 147
R120 47
MC14572UB
Q22 A836
R51 220k
R52 10k
R54 10k
R53 100k
Q23 C458
R48 3MF
R50 100k
R49 22k
Q8 K30
Q9 C458
R43 100k
R42 100kF
R44 100kF
R45 300kF
R46 500kF
R125 47K
VR14 100K
TC2 10P
C22 15P
TC1 10P
CC
2-8
1-1
2-1
1-8
D21 IS1588
R98 100k 1 4
HZ12C2
+5V
Q17 C458
R84 22
+12V
R83 8.2k
R118 3.9K
R112 22
R92 22
Q25 C458
R90 22
Q19 C1628
R95 6.8k
3P
L4
820µ
500V
R96 100
R99 22
(TO CRT)
P3
Q21 C458
C36 000P
L2
D12 HZ5
R88 360
VR11 220
VR12 470
C38 47P
R87 360
R86 470
C37
220P
R85 22
Q18
VR10 1K
R114 1K
R116 33K
R115 1K
R117 750 1/2
R113 22
Q26 C456
R91 22
Q20 C1628
R94 6.8K
L5
820µ
0.01 CK
250V 47µ
C41
R97 100
C40
R119 3.9K
R93 22
D20 1S1588
C55 50V 1µ
-15v
-8V
+5Vb
-12V

DIAGRAM

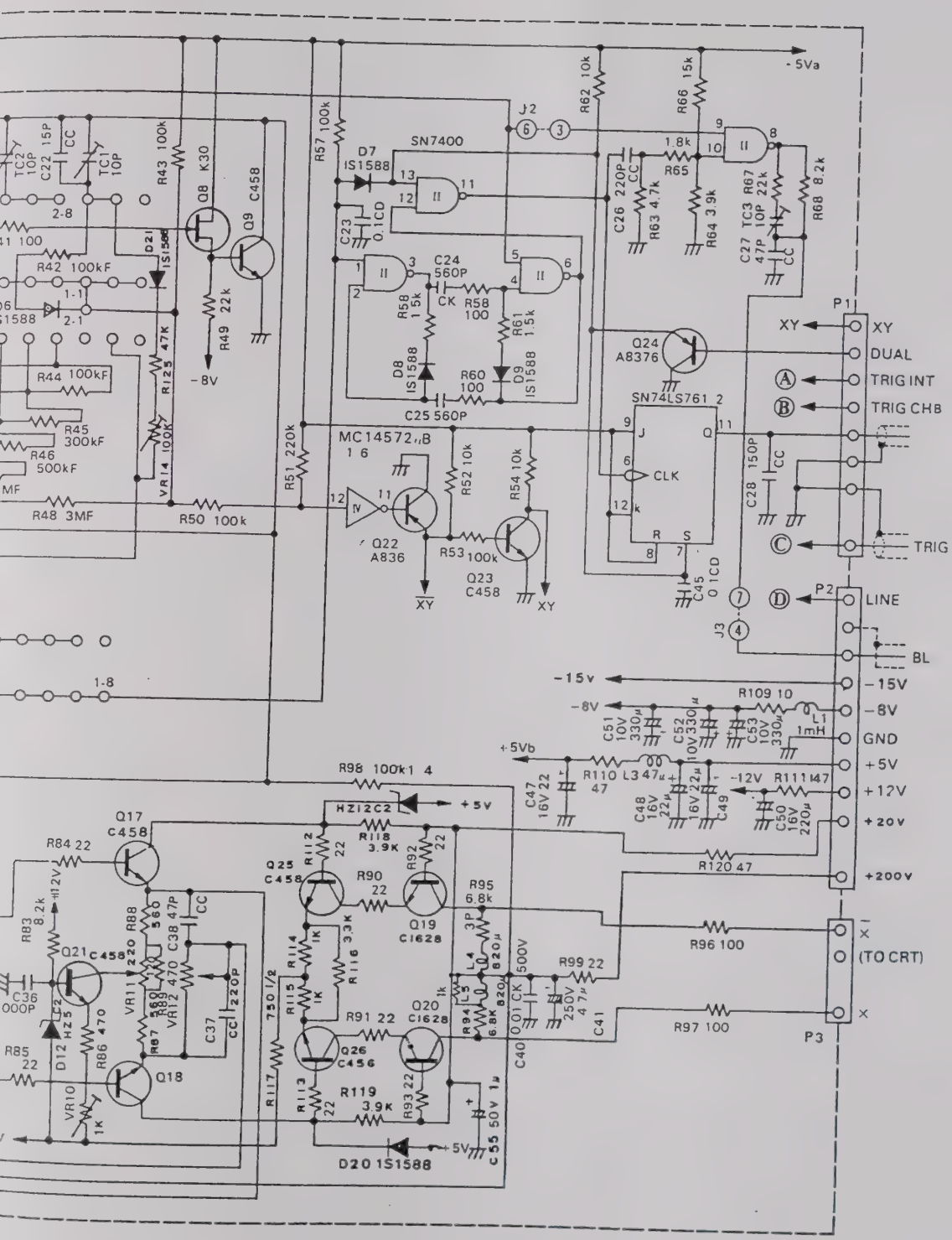


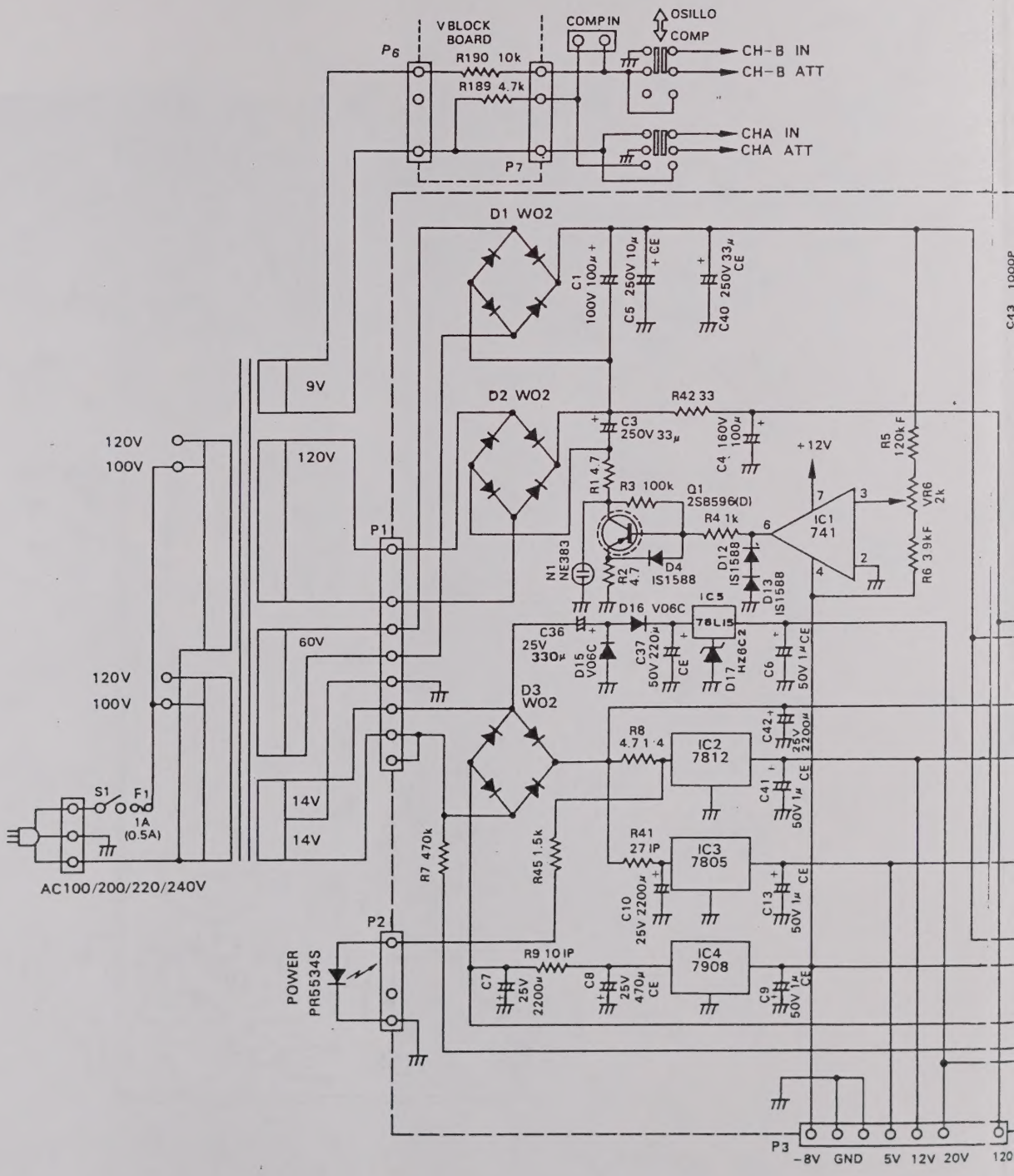
7-3 POWER SUPPLY CIRCU

290-1017-33


FOCUS 2MΩ
P7
F1 f0.5A
C38 0.01 2kV
D6 Y16GA
R10 10MIP
C50 102P 500V
R18 1M 1/4
C51 102P 500V
R24 100k S14
102P 500V
C32
R20 47k
D18 Y16GA
C18 0.01 2kV
C19 0.01
C21 0.01
C20 0.01
D7 ISS83
R23 22M S14
R22 22M S14
N4
N3
N2
C16 0.01 CK
R12 33k
R13 1k
Q3 2SA836
Q2 2SC458
R15 47k
R16 47k
R17 390
Q4 2SD401
R21 220k
C22 0.01 500V
C23 0.01 2kV
D8 ISS83
R19 4.7 S14
D9 ISS83
D10 ISS83
C24 250V 1μ CE
C25 0.01 CK
R25 68k
P6
INTENSITY 50kΩ
VR5 100k
VR1 50k
R11 120k
C39 4700P
R14 10k
S1 10k
C14 0.047 CQ
Q8 2SC 1885
R28 220k
R29 22
R27 100
C29 0.01 500V
R31 180
L2 4.7μ
C28 0.1 CD
D11 H25C2
R32 1k
R33 120k
C30 500V 0.5P CC
R43 1.8M
Q12 2SC1885
VR3 1M JEOME
VR4 1M ASTIG
C27 0.01 CK
R26 100k
C34 500V 1000P
R30 22
Q9 2SC 1885
R37 3.9k
R38 33k
D14 H2483
C31 0.1 CQ
R40 1k
P5
Z INPUT
R34 22
Q10 2SC458
R36 100
Q11 2SA836
R39 47k
C35 104P
VR2 10k
R35 15k
Q5 2SC458
Q6 2SA836
C17 25V 1μ CE
P8
P4
P9
LINE
- 15V 8V GND 5V 12V 20V 200V
BL
TO TIME BASE BLOK
TRACE ROTATOR 50kΩ

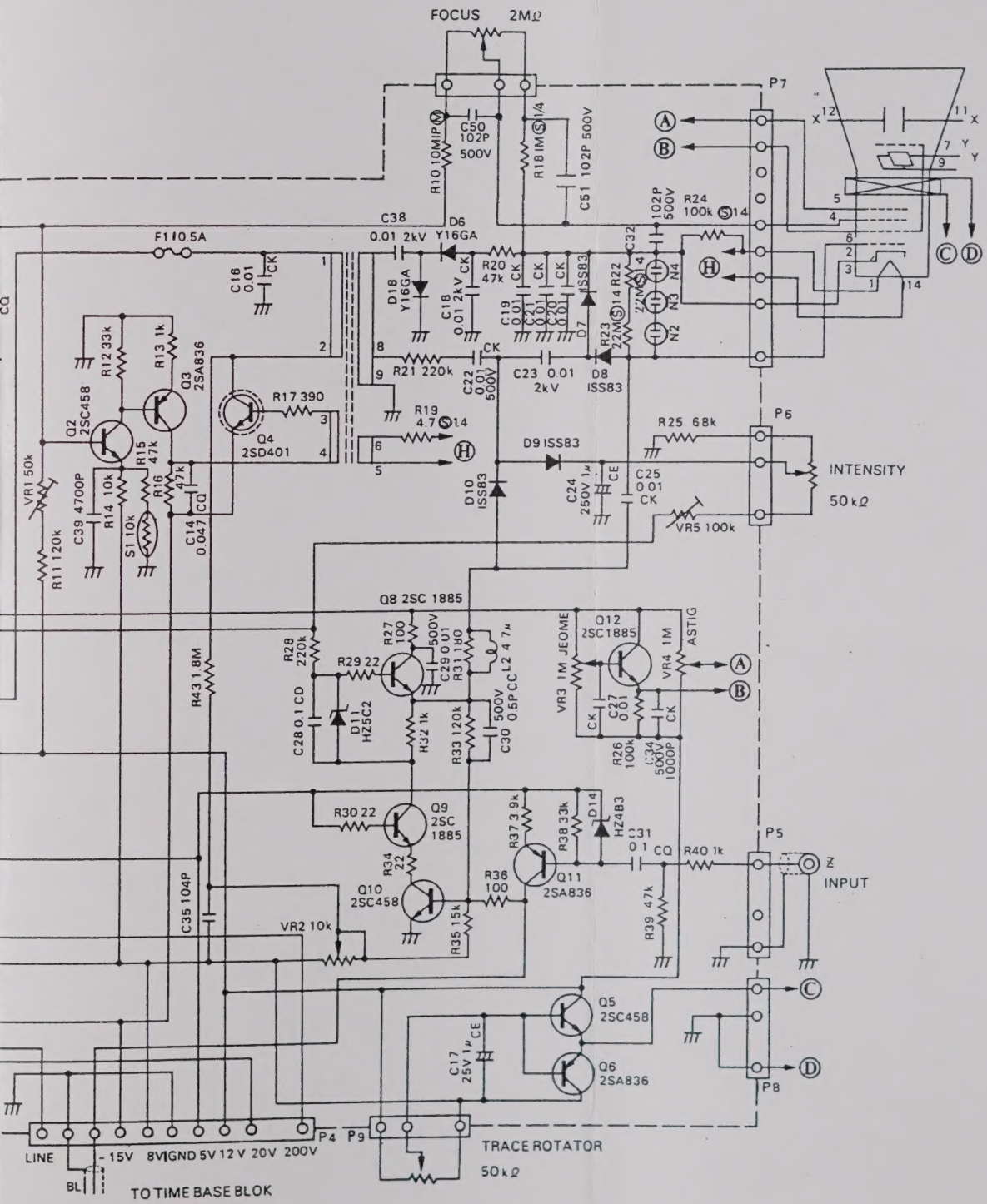
IT DIAGRAM


-5Va
SN7400
D7 IS1588
R62 10k
R66 15k
R65
R63 4.7k
R64 3.9k
R68 8.2k
C26 220P
C27 TC3 47P 10P 22k
C23 0.1CD
C24 560P
C25 560P
R58 15k
R58 100
R61 1.5k
R60 100
D8 IS1588
D9 IS1588
R57 100k
R43 100k
R42 100kF
R44 100kF
R45 300kF
R46 500kF
R48 3MF
R50 100k
R125 47K
VR14 100K
R49 22k
-8V
Q8 K30
Q9 C458
TC2 10P
C22 15P
TC1 10P
2-8
1-1
2-1
1-8
MC14572 1 6
R51 220k
R52 10k
R54 10k
R53 100k
Q22 A836
Q23 C458
XY
SN74LS761 2
CLK
R S
C45 0 1CD
C28 150P
Q24 A8376
P1
XY
DUAL
TRIG INT
TRIG CHB
TRIG
P2
LINE
BL
J2
J3
-15v
-8V
GND
+5V
+12V
+20v
+200v
R109 10
L1 1mH
C51 10V 330μ
C52 10V 330μ
C53 10V 330μ
+5Vb
R110 L3 47μ
47
C47 16V 22
C48 16V 22μ
C49 16V 22μ
-12V
R111 47
C50 16V 220μ
R120 47
R98 100k 1 4
HZ12C2
+5V
Q17 C458
R84 22
+12V
R83 8.2k
R118 3.9K
R112 22
R92 22
Q25 C458
R90 22
Q19 C1628
R95 6.8k
3P
L4
820μ
500V
R96 100
R99 22
0.01 CK
250V 4.7μ
C41
R97 100
P3
(TO CRT)
Q21 C458
C36 000P
D12 HZ5
L2
R88 560
VR11 220
VR12 470
C38 47P
C37 220P
R87 560
R86 470
Q18
R85 22
VR10 1K
R114 1K
R116 33K
R115 1K
R117 750 1/2
R94 6.8K
L5
Q20 C1628
Q26 C456
R91 22
R113 22
R119 3.9K
R93 22
C40
C55 50V 1μ
D20 1S1588



7-3 POWER SUPPLY CIRC

290-1017-33


FOCUS 2MΩ
P7
F1 0.5A
C38 0.01 2kV
D6 Y16GA
R20 47k
C23 0.01 2kV
D8 ISS83
R21 220k
R19 4.7
D9 ISS83
D10 ISS83
R25 68k
P6
INTENSITY 50kΩ
VR5 100k
Q8 2SC 1885
Q12 2SC1885
VR3 1M JEOME
VR4 1M ASTIG
R27 100
R28 220k
R29 22
R31 180
R32 1k
R33 120k
R26 100k
Q9 2SC 1885
Q10 2SC458
Q11 2SA836
R30 22
R34 22
R36 100
R37 3.9k
R38 33k
R40 1k
R39 47k
P5
INPUT
VR2 10k
C35 104P
Q5 2SC458
Q6 2SA836
C17 25V 1μ
P8
P4
P9
LINE
-15V 8V GND 5V 12V 20V 200V
BL
TO TIME BASE BLOK
TRACE ROTATOR 50kΩ
Q2 2SC458
Q3 2SA836
Q4 2SD401
R17 390
R12 33k
R13 1k
R15 47k
R16 47k
R14 10k
R11 120k
VR1 50k
S1 10k
C39 4700P
C14 0.047
C16 0.01
D18 Y16GA
C18 0.01 2kV
R18 1M
C50 102P 500V
R10 10MΩ
C51 102P 500V
R24 100k
R22 22M
R23 22M
C32 102P 500V
C19 C21 C20 0.01
D7 ISS83
C22 0.01 500V
R43 1.8M
C28 0.1 CD
D11 HZ5C2
C29 0.01
C30 0.5PCC
L2 4.7μ
C27 0.01
C34 500V 1000P
C31 0.1 CQ
R41 1.8M
D14 HZ4B3
C24 250V 1μ
C25 0.01 CK

IT DIAGRAM